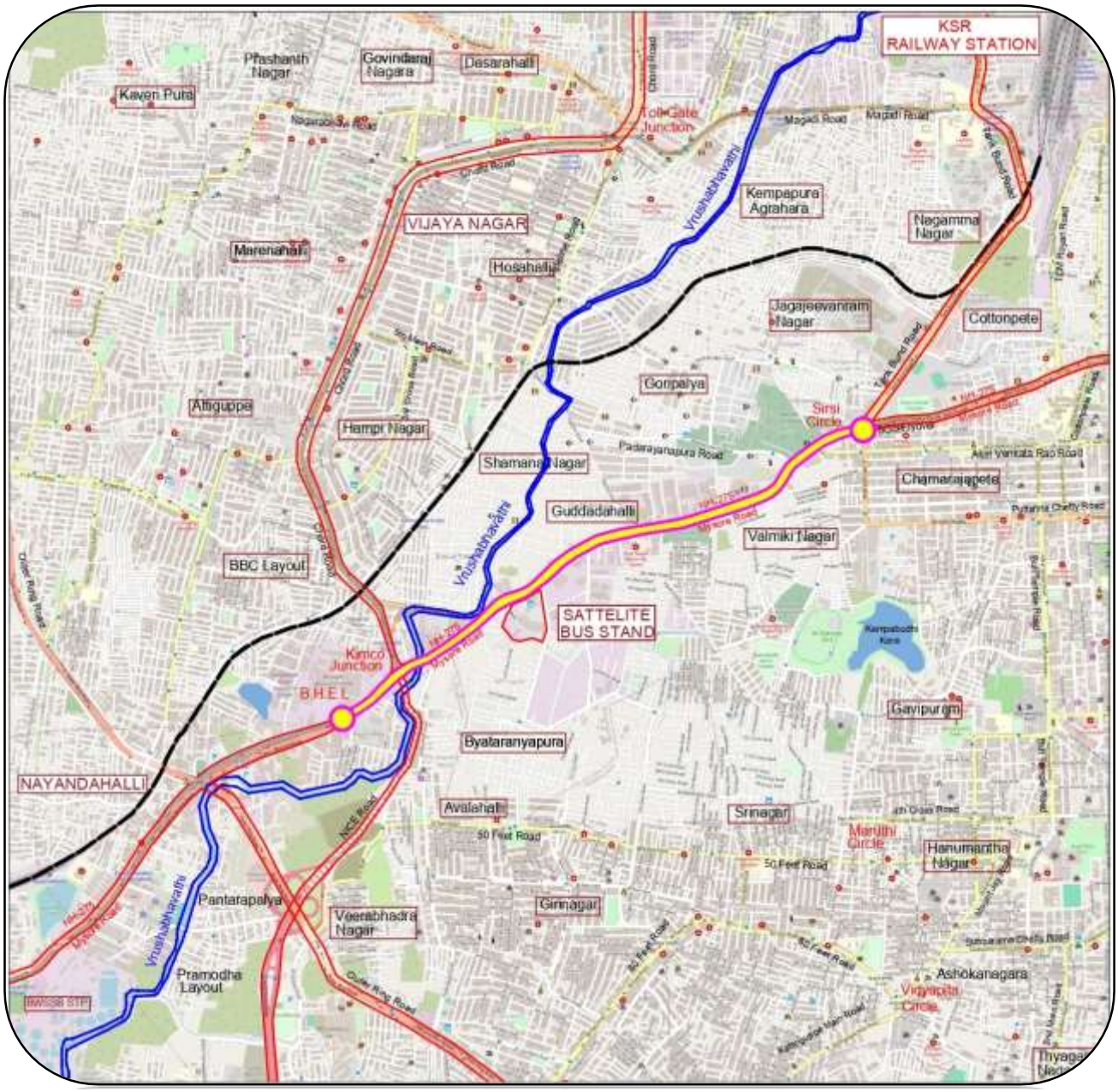
BENGALURU SMART INFRASTRUCTURE LIMITED (B – SMILE)
Office of the Chief Engineer-02
#30/1, Thimmaiah Road, Miller Tank Bund Area,
Vasanthnagar, Bengaluru - 560052.

Construction of Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road



Consultant: **Siddi Shakthi Projects**

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Detailed Project Report
Project Cost = 810.00 Crores
February – 2026
Volume-I

Index

Sl. No	Table of Contents		Page No.
1	**Certificate**		1
	Summary of Project Report		2
	1.0	**Introduction**	
		General	3-4
	1.1	Background	4-5
	1.2	Development of Bengaluru	5
	1.3	Project road	6-7
	1.4	Development of Project Road	7
	1.5	Proposal for Project Road Development	7
	1.6	Project Location and Salient Features	8-18
	1.7	Existing Project Road Details	19-21
	1.7.1	Present Traffic Circulation flow of the Project Road	21-23
	1.7.2	Seismic Analysis	24-25
	1.7.3	Revised Master Plan of Bengaluru -2015	25-26
	1.7.4	Project Jurisdiction	27
	1.7.5	Revenue Villages	27
	1.8	Objective of the Project	27-28
	1.8.1	Advantages of the proposed project	28
	1.9	Appointment of Consultant for Preparation of Detailed Project Report (DPR)	29
	1.10	Objective of the Study	29
	1.11	Scope of Consultancy Service	29-30
	1.12	Broad Methodology adapted	30-31
	1.13	Deliverables	32
2	**2.0**	**Survey and Investigation**	
	2.1	General	33
	2.2	Reconnaissance Survey	33
	2.2.1	Data collection for Topographical survey	34-35
	2.2.2	GTS Bench marks	35-36
	2.3	Topographical Survey	36-37
	2.3.1	Detailed Survey of Topographical Features	38-39
	2.3.2	List of Temporary Bench Mark	39-41
	2.4	Traffic Survey	41

Sl. No	Table of Contents	Page No.
	2.5 Geo Technical Investigations	41-49
	2.6 Project Road Inventory	50-52
	2.7 Existing Cross Section of the project road	53-60
	2.8 Project Road Images	61-70
3	**3.0 Methodology and Design Standards**	
	3.1 General	71
	3.2 Study of Existing Project Road	71
	3.3 Augmentation of Traffic capacity	71-72
	3.4 Structural type Options	72
	3.4.1 Elevated Road with Pre-cast I- Girder	73
	3.4.2 Elevated road with Box Girder with full span precast	73-74
	3.4.3 Elevated road with Segmental pre-cast Box girder	74-86
	3.5 Recommendation of Structural elements for super structure	86-87
	3.5.1 Comparison of Cost by use of UHPFRC and HSC Concrete	87-90
	3.6 Design Standards	91
	3.6.1 Planning of Geometry and Structural Design Standards	91
	3.6.2 Geometry	91
	3.6.3 Carriageway Width	91
	3.6.4 Design Speed	91
	3.6.5 Horizontal Curves	91
	3.6.6 Widening at Curves	91
	3.6.7 Sight Distance	92
	3.6.8 Clearances at Elevated Structures	92
	3.6.9 Super-elevation	92
	3.6.10 Gradient and Profile	92
	3.6.11 Drainage	92
	3.6.12 Camber	93
	3.6.13 Railings, Parapet or Crash Barriers	93
	3.7 Design Standards of Structures	93
	3.7.1 Materials of Construction & Specifications	93
	3.7.2 Loads	93-94
	3.7.3 Minimum Dimensions	94
	3.7.4 Design for Continuity	94-96
	3.8 Approaches to Elevated structures in Urban Locations	96
	3.8.1 Retaining Walls and Return Walls	96-97

Sl. No	Table of Contents		Page No.
4	**4.0**	**Design report with Improvement Proposals**	
	4.1	Elevated Corridor and approaches	98
	4.1.1	Proposal from Starts to End of Project road	98-99
	4.1.2	Features of Elevated Corridor	99
	4.2	At Grade Road improvement	99-100
	4.3	Proposed for Land Acquisition	100-102
	4.4	Structural type Proposed for Elevated Corridor	102
	4.4.1	Superstructure of Elevated Corridor	102
	4.4.2	Substructure	103
	4.4.3	Foundation	103
	4.4.4	Utility Relocation Plan	103
5	**5.0**	**Traffic Study**	
	5.1	Analysis of Existing Traffic and Forecast	104
	5.1.1	Traffic Survey between Sirsi Circle – Nayandahalli	104-105
	5.1.2	Peak Hour Traffic	106
	5.1.3	Composition of Traffic	106
	5.1.4	Growth of Traffic	107-108
	5.1.5	Peak Hour Growth of Traffic	108
	5.1.6	Traffic Capacity of Project Road	109
	5.1.7	Traffic Study for Toll Assessment	110
6	**6.0**	**Design Drawings**	111
7	**7.0**	**Project Costings**	112
	7.1	Bill of Quantities	112
	7.1.1	Civil Works	112-114
	7.1.2	The Project Amount Called in the Tender	114
	7.1.3	Goods & Service Tax (GST)	114
	7.1.4	Provisional Sum	114
	7.2	Rate Analysis	114-115
	7.3	Estimated Costs	115-117
	7.4	Compensatory afforestation	117
	7.5	Re-usage of released materials	117-118
	7.6	Structural Area Statement of Proposed Project	119-120
	7.7	Justification of Project Cost	121-124

Sl. No	Table of Contents	Page No.
8	**8.0 Environmental Impact Assessment Study**	
	8.1 Back Ground	125
	8.2 Land Use and Roadside Environments	126
	8.2.1 Climate	126-127
	8.2.2 Humidity	127
	8.2.3 Temperature	127
	8.3 Legal Framework of Government of India	127
	8.3.1 Key Environmental Laws and Regulations	127-130
9	**9.0 Review of Detailed Project Report (DPR) by Expert Committees**	131
	9.1 Expert Committees Review	131
	9.1.1 Discussion at GBA Technical Advisory Committee	131-132
	9.1.2 Review by various Organisations of Government	132
	9.1.3 Discussion with Bengaluru Metro Rail Corporation Limited (BMRCL)	132-133
	9.1.4 Review of Detailed Project Report by DULT	133-138
10	**10.0 Economic Internal Rate of Return.**	
	10.1 Introduction	139
	10.2 Traffic Survey and Economic Evaluation	140
	10.2.1 Projected traffic	140
	10.2.2 Summary of Projected Traffic (5-Year Intervals)	140
	10.2.3 Detailed Projection by Vehicle Category (2025–2050)	141
	10.3 Financial Models Overview for the proposed elevated corridor	141-143
	10.4 Assumptions for study	143
	10.5 Economic Internal Rate of Return (EIRR)	144-146
	10.6 Economic Benefits	146-149
11	**11 Conclusion with Recommendation**	150-154
12	**References used for Preparation of Detailed Project Report (DPR)**	
	Normative Cost of NH/NHAI	155-172
	Use of UHPFRC Circular issued by MORT&H	173-175
	Guideline for use of UHPFRC issued by Ministry of Railways	176-178
	Guideline Value of 2023-24 issued by Karnataka Government Dated:27-09-2023	179-181
	Circular for Maintenance Charges issued by MORT&H	182-184
	Plinth Area Rates of CPWD-2025	185-186
	Dult Observation on Detailed Project Report (DPR)	187-211
	Government Order to Submit Final Detailed Project Report (DPR)	212

Sl. No	Table of Contents	Page No.
13	Scope of work and design criteria for contract (To be referred along with tender document/RFP)	
	Scope of Work	213
	General	213
	Site	214-215
	Works to be carried out	216-220
	Design Criteria	221
	General and Approach to Work Site	221
	Benchmarks and Setting out of Works	221-222
	General Requirements	222-223
	Specifications for Design and Codes to be followed	223-224
	Order of Precedence in case of Conflict	225
	Soil Investigation to be carried out by the Contractor	225
	Restrictions on Type of Structures	225-226
	Concept and Alignment plan of Elevated Corridor	226
	Structural Construction Scope for Proposed Elevated Corridor	227
	At Grade Road Maintenance / Reconstruction & Utility Corridor Works	228-229
	Design Data	229-231
	Description of Work and Elevated Corridor Provisions for Alternative Proposals	231-232
	Design Loads	232-233
	Durability	233
	Foundation	233-236
	Substructure	236
	Superstructure	236-238
	Bearings below Superstructure	238-239
	Expansion Joints	239
	Crash Barrier.	239
	Drainage	239-240
	Wearing Coat	240
	Approach Slab	240
	Electrical Works and Illumination	240
	Integrity Test	240
	Painting and Protective Coating System	241
	Specialized Agency for Design and Manufacture of UHPFRC Girders	241-242

Sl. No	Table of Contents	Page No.
13	Load Testing	242-243
	Slip Roads, other Surface Level Roads, Culverts and Junction Improvements	243-244
	Submission of Elevated Corridor/Rotary design Reports for approval	244
	Safety precautions and measures to be observed during execution of Elevated Rotary works in Project road and Adjoining areas	244
	Traffic Diversion and Traffic Management during Construction	245-246
	Traffic Signs, Markings and other Road Appurtenances	246
	Drainage System	246
	Carriageway Improvement Works	246-247
	Paved Pedestrian Crossing / Footpath and Utility Crossing Works	247-248
	Pipe Duct / Drainage and Utility Crossing Works	248
	Road Side Existing Drain	248-249
	Improvement / Reconstruction of Existing RCC Covered Drain with Precast Slabs	249-250
	Kerb Works	250
	Footpath and Pedestrian Facilities	250-251
	Illumination and Electrical Works	251
	Traffic Signage, Road Safety and Pavement Marking Works	252
	Project Information and Display Boards	252-253
	Project Cost Estimate and Scope Consideration	253
	Documentation, Instrumentation, etc.	253-254
	Programme for Submission and Approval of Designs and Drawings	254-255
	Resource Planning and Deployment of Major Construction Equipment	255-257
	Construction Schedule	257
	Site Office	257
	Field Laboratory	257-258
	General	258
	For Soils and Aggregates	258
	For Cement and Cement Concrete	259
	Casting Yard	259
	Disputes	259
	Maintenance after Defect liability period.	259-260
14	Abstract of Estimate	261

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REF: SSP/OC/25-26/0106 **Date: 20-02-2026**

CERTIFICATE

Name of the Project	:	Construction of Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road.
Total Project Cost	:	**Rs. 810.00 Crores (Proposed to implement under EPC Model)**
Grant	:	1. Brand Bengaluru 2. Budget 2025-26, Dated: 7th March 2025, Urban Development, Sl. No. 283 (ii), Page No. 79 3. Subject No 448/2024-25. For Preparation Detailed Project Report (DPR)
Tendering Authority	:	Bengaluru smart infrastructure limited (B – SMILE) No.30/1, Thimmaiah Road, Millar Tank bund Area, Vasanthnagar, Bengaluru-560051.
Project Consultant	:	**Siddi Shakthi Projects,** No.93/31, Asha Nivas, TG Layout, Ittamadu, Banashankari 3rd Stage, Hosakerehalli Post, Bengaluru – 560085.
Name of the Assignment	:	Preparation of Detailed Project Report (DPR)
Period of Preparation of Detailed Project Report	:	21-04-2025 to 22-01-2026
Report submitted to	:	Bengaluru smart infrastructure limited (B – SMILE) No.30/1, Thimmaiah Road, Millar Tank bund Area, Vasanthnagar, Bengaluru-560051.
Report prepared by	:	**Mr. H.V. Mallikarjuna,** Team Leader
Reviewed by	:	**Dr. Mandar V.Sardesai,** Advisor (Structures)
Approved by	:	**Mr. M. Kannan,** Chief Executive Officer
Total No. of Pages	:	**Detailed Project Report** **Volume- I : 1 to 261**

Thanking and assuring you of our best services at all times,

For Siddi Shakthi Projects,

Authorized Signatory

Notes:

- This report is Prepared only for the purpose of tendering for the specified project. If any substantial change in the report is noticed, the same should be brought to the notice of **Siddi Shakthi Projects,** if found necessary, recommendations and appropriate modifications shall be Suggested.
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- Any correction made shall invalidates this report.

Executive Summary &Techno-Economic Details (Brief Overview of DPR)

Sl No	Description	Details
1	Name of Project	Construction of Proposed Elevated Corridor from **Sirsi Circle to Nayandahalli on Mysuru Road**
2	Length of the project	4.5 km
3	Total length of elevated structures with a span of 45m including four lane straight reaches, split flyover in the form of loops and approaches.	6.74 Km Four lane carriage way 20.20m = 1.82 km Two lane carriage way 8.50/7.0m = 4.92 km
4	Structural area of deck slab Including Approach viaduct and area of Solid approach ramp (RE Wall)	72156.4 Sqm (Viaduct) + 4405Sqm (approach) The project incorporates advanced structural technology using **UHPFRC girders** to achieve longer spans, reduced structural depth, and optimized lifecycle performance.
5	Allied works including improvement and reconstruction of road, footpath, drain, utility ducts etc.	4.70 Km
6	Total Civil cost for execution of the project	Rs 538.28 Cr
7	Total Provisional Cost including GST and other miscellaneous like price escalation, utility shifting, PMC charges,	Rs 271.72 Cr (inclusive of Land acquisition cost of Rs 96.4Cr)
8	Total Project Cost Including civil and provisional cost	Rs 810.00 Cr
9	Structural Cost / Sqm	Rs 69,860/Sqm
10	Structural cost per Sqm in terms of overall finishing work of flyover and at grade road work including all allied works	Rs 74,600/Sqm
11	Normative cost of MORT&H for Flyover / Sqm	Rs 40,000/Sqm (does not include finishing work, at grade road work etc.,) location considered to be in non-urban area
12	Cost / Sqm of Structural area compared to Ongoing work at Nagpur flyover with UHPFRC Girder	Rs 56,280/Sqm (without improvement works)
13	Structural cost / Sqm , for this Project if executed with typical type of flyover with segmental Box Girder with a span of 30m	Rs 96,377/Sqm as against UHPFRC Girder cost of Rs 69,860/Sqm
14	Economical Internal Rate of Return	With an EIRR of 18.7% (>12%) and a BCR of 2.48 (>1), the project is economically viable and recommended for implementation."
15	Concept plan, Technical feature were reviewed by Stalk holder of Govt. Agencies	NHAI, DULT,BMRCL,BWSSB , Commissioner of Traffic Police, Technical Advisory Committee of BSMILE
16	Mode of Tender	Engineering, Procurement and Construction (EPC)

1 Introduction

General

Bengaluru, one of India's major metropolitan cities, has witnessed rapid urbanization driven by population growth, economic expansion, and spatial development. This has resulted in a steep rise in urban travel demand. Unfortunately, the surge in travel demand has led to several undesirable consequences, the most significant being the exponential growth in motor vehicle ownership. Simultaneously, the share of public transport has declined, with commuters increasingly relying on personal vehicles. This trend has imposed serious costs in the form of traffic congestion, travel delays, productivity losses, deteriorating air quality, and rising road accidents.

Projections indicate that by 2031, Bengaluru's population will far exceed current expectations, translating into nearly double the present volume of daily vehicle trips. This escalation poses a critical challenge to the city's quality of life. Importantly, travel demand is closely linked to economic growth, which in Bengaluru is progressing at an even faster pace than population growth. Proactive measures are therefore essential to address the emerging situation.

Over the past decade, Bengaluru has seen considerable investment in transport infrastructure, including IT parks, ring roads, flyovers, bridges, and underpasses. While these projects were intended to ease congestion, the city continues to face severe traffic bottlenecks. Vehicle registrations are increasing by 400,000–600,000 annually, while the total road length remains largely unchanged. Several junctions have already exceeded their design capacity, necessitating immediate interventions to improve traffic flow.

Urban transport in Bengaluru is predominantly road-based. National rail lines were not designed to serve urban and regional traffic, with infrequent stations and low service frequency. Road traffic is dominated by motorized two-wheelers and auto-rickshaws. Public transport, primarily operated by the Bangalore Metropolitan Transport Corporation (BMTC), functions in mixed traffic without dedicated lanes or signal priority. Many companies also operate private minibus fleets for employee transport. The BMTC network, though extensive, is diffuse and characterized by low service frequency. Metro connectivity through BMRCL is expanding, but remains insufficient to meet the city's growing demand.

Despite the construction of multiple flyovers and grade separators by the Bangalore Development Authority (BDA) and Bruhat Bengaluru Mahanagara Palike (BBMP), congestion persists. The city's road network, largely laid out in the 1940s when the population was under half a million, is underdeveloped in terms of size, continuity, and connectivity. Today, links and intersections operate at or above capacity. Average journey speeds on key central roads during peak hours range between 5–

13.5 kmph, making daily commuting highly inefficient. Nearly all major junctions are over capacity, and traffic growth has far outpaced infrastructure expansion.

Bengaluru, the fifth largest city in India, has an estimated population of 14 million spread over 821 sq. km. Vehicle growth rates exceed 15% annually, compared to a population growth rate of 5%. The city's radial road network comprises six National Highways and five State Highways, supplemented by circumferential roads such as the Inner Ring Road, Intermediate Ring Road, Outer Ring Road, West of Chord Road, NICE Corridor, Airport Road, and the Peripheral Ring Road (under construction).

Recognizing the gravity of the situation, the Government of Karnataka, under the Greater Bengaluru Authority (GBA), has established Bengaluru Smart Infrastructure Limited (B-SMILE), a Special Purpose Vehicle (SPV) to implement mega infrastructure projects. These include:

- Underground Vehicular Tunnels: North–South Corridor (Hebbala to Silk Board, 18 km) and East–West Corridor (K.R. Puram to Nayandahalli, 24 km).
- Elevated Flyover Corridors & Double-Decker Flyovers: 120 km.
- White topping (PQC) of Major Roads: 350 km.
- Road Widening Projects: Over 50 km within the city.
- Buffer Zone Road Construction: More than 300 km along lakes and storm water drains.

These initiatives, including the proposed Elevated Corridor Project, are critical to addressing Bengaluru's escalating traffic congestion, improving mobility, and sustaining economic growth.

1.1 Background

Bengaluru, historically founded by Kempe Gowda, a feudatory of the Vijayanagara Empire, was once renowned for its lush greenery and abundant water bodies. In the 1970s, the city enjoyed a green cover of nearly 68%, with splendid lakes, numerous parks, and tree-lined avenues defining its landscape. Until that period, Bengaluru's economy was primarily driven by the manufacturing sector. Post-Independence, preferential policies of the Government of India further strengthened the city's economic base, with several Public Sector Undertakings (PSUs) establishing their headquarters here. The presence of reputed universities and colleges added to its stature as an educational hub.

The State Government's initiatives in the Information Technology sector, such as the establishment of the Karnataka State Electronics Development Corporation (Keonics) and the creation of Electronics City, provided a major boost to industrial growth. The availability of quality education, coupled with the emergence of new industries, created vast opportunities for the youth, leading to large-scale migration into the city. This sudden influx posed challenges for the Bengaluru Mahanagara Palike, which struggled to meet the growing demands. Numerous unplanned revenue layouts emerged across the city, many of

which fell outside the jurisdiction of the Municipal Corporation and were consequently neglected in terms of infrastructure and services.

Bengaluru's success in attracting large-scale private investment from across the globe further accelerated its growth trajectory. Between 1993 and 2004, while India's GDP grew at an average rate of 7.93%, Bengaluru recorded an impressive 20.76% growth rate. The city's IT sector, contributing nearly 40% of India's software exports, played a pivotal role in bridging the nation's trade deficit and cementing Bengaluru's reputation as the "Silicon Valley of India."

However, this remarkable growth story has been accompanied by significant infrastructure-related challenges. Traffic congestion, deteriorating air quality, poor waste management, water scarcity, and inadequate road maintenance have adversely impacted the quality of life in the city. These issues have also affected the image of "Brand Bengaluru," underscoring the urgent need for sustainable infrastructure solutions. The proposed Elevated Corridor Project from Sirsi Circle to Nayandahalli is one such initiative aimed at addressing these challenges by improving mobility, reducing congestion, and supporting the city's continued economic growth.

1.2 Development of Bengaluru

Bengaluru, with a current population of approximately 14 million, has been growing at an annual rate of 3.25% over the last decade. This rapid urban expansion has been accompanied by a phenomenal increase in vehicle ownership, particularly two-wheelers and four-wheelers, driven by rising household incomes. The number of registered motor vehicles has already crossed 12 million, placing immense pressure on the city's limited road network.

In the absence of an adequately developed public transport system, citizens have increasingly relied on personalized modes of travel. This has resulted in severe traffic congestion, escalating environmental pollution, and declining urban mobility. Studies indicate that an average citizen of Bengaluru spends more than 240 hours annually stuck in traffic. Such delays translate into significant productivity losses, deterioration of air quality, reduced quality of life, and increased costs for goods and services.

Traffic composition on Bengaluru's roads reveals a disproportionately high share of two-wheelers, with the share of cars also rising steadily. This trend underscores the inadequacy of the existing public transport system. Volume-to-Capacity (V/C) ratios on most arterial roads exceed 1.0, indicating oversaturation. The overall average traffic speed during peak hours is approximately 13.5 kmph, reflecting severe congestion and inefficiency in the transport network.

These conditions highlight the urgent need to augment road capacity while simultaneously planning and implementing high-capacity mass transit systems along critical corridors. The proposed Elevated Corridor Project from Sirsi Circle to Nayandahalli is a strategic intervention aimed at addressing these challenges, improving mobility, and supporting the sustainable growth of Bengaluru.

1.3 Project road

The proposed project corridor is from Sirsi Circle to Nayandahalli along Mysuru Road, which connects directly to the Mysuru Expressway (National Highway 275). This route is one of the busiest traffic corridors in Bengaluru, experiencing significant congestion, particularly during peak hours. It serves as a vital link to the south-western part of the city, passing through key commercial and residential areas. Several factors contribute to the persistent congestion along this stretch:

1. **High Volume of Commuter and Commercial Traffic**

The corridor caters to a large number of office-goers and commercial establishments. Retail outlets, business hubs, and residential clusters along the route ensure that traffic remains consistently heavy throughout the day, with peak congestion during morning and evening commute hours.

2. **Signal Coordination Challenges**

Existing traffic signals, particularly at intersections such as Deepanjali Nagar and Nayandahalli, are unable to manage the high traffic volumes effectively. Adaptive traffic signal systems, which adjust based on real-time conditions, could improve flow but remain limited in application.

3**. Metro Connectivity**

The construction and expansion of metro lines along this corridor have provided commuters with an alternative mode of travel. However, metro capacity is still insufficient to offset the growing reliance on private vehicles.

4. **Stop-and-Go Movement**

Heavy traffic volumes, frequent signals, and pedestrian crossings result in stop-and-go movement throughout the stretch. This pattern is especially evident near major intersections, with congestion observed at nearly seven critical junctions along the route.

5. **Peak Hour Delays**

Morning (8:00–11:00 a.m.) and evening (5:00–8:00 p.m.) rush hours witness the highest delays. Travel times increase considerably on Fridays and during rainy weather, further slowing traffic and compounding commuter frustration.

6. **Environmental Concerns**

Stop-and-go traffic and prolonged idling contribute to higher emissions and deteriorating air quality. An elevated corridor would reduce surface-level congestion, improve fuel efficiency, and lower pollution levels in densely populated areas such as K.R. Market, Chamarajapete, Byatarayanapura, and Nayandahalli.

The Sirsi Circle–Nayandahalli Elevated Corridor Project is therefore a critical intervention aimed at:

- Decongesting one of Bengaluru's busiest arterial routes.
- Improving travel time reliability and commuter productivity.
- Enhancing environmental sustainability by reducing vehicular emissions.
- Supporting the city's long-term mobility and economic growth.

1.4 Development of Project Road

The proposed project corridor from Sirsi Circle to Nayandahalli along Mysuru Road passes through some of Bengaluru's most prominent commercial and institutional hubs. The stretch encompasses K.R. Market, Gopalan Mall, Satellite Bus Stand, and several surrounding neighborhoods that have evolved into vibrant centers of economic activity. Over the years, this area has also become a hub for the start-up community, owing to its proximity to the Central Business District (CBD) and easy accessibility to other parts of the city.

Commercial development along this corridor has been rapid and diverse. Numerous clusters of retail outlets, business establishments, restaurants, and eateries have emerged, creating a dense mix of commercial and residential activity. The presence of large markets, shopping complexes, and transit facilities such as the Satellite Bus Stand has further intensified traffic demand along this route. The corridor has thus become a critical artery for both commuter traffic and commercial movement, but the resulting congestion has significantly impacted mobility and air quality.

1.5 Proposal for Project Road Development

The proposed project involves the construction of an Elevated Corridor from Sirsi Circle to Nayandahalli along Mysuru Road, a critical arterial route connecting the south-western part of Bengaluru to the Mysuru Expressway (NH-275). This corridor currently experiences severe congestion due to high traffic volumes, mixed land use, and inadequate road capacity.

Presently, the average travel speed along the corridor is only 20–25 kmph throughout the day, with frequent traffic jams. There are approximately seven major junctions along this stretch, where waiting times and vehicle queues during peak hours are particularly high. In addition, pedestrian volumes are significant due to dense commercial activity along the project road, further contributing to traffic delays and safety concerns.

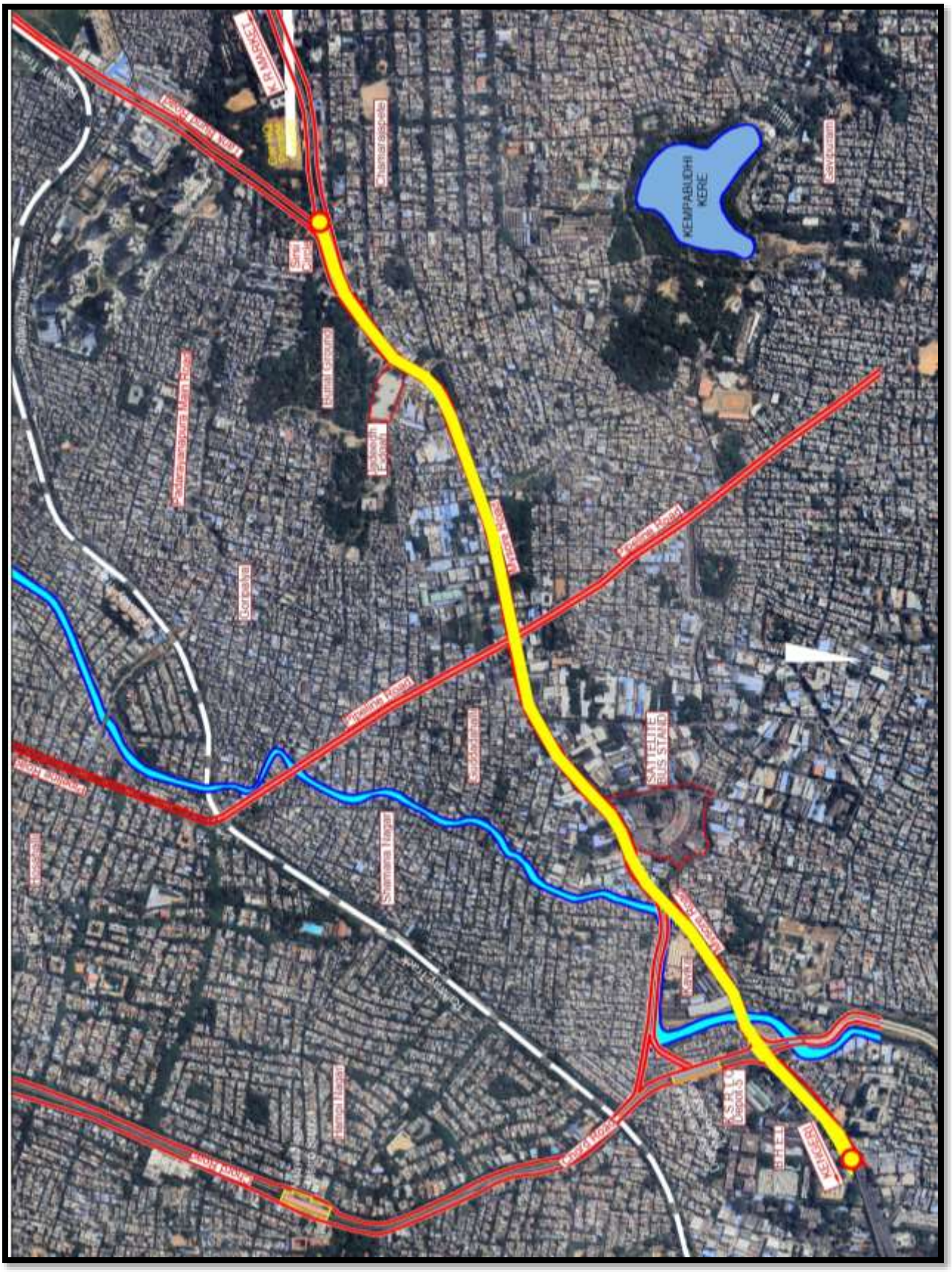
To ensure free-flowing traffic movement and reduce congestion at the surface level, the construction of an elevated corridor is essential. This intervention will:

- Provide uninterrupted passage for through traffic.
- Reduce delays at junctions and minimize stop-and-go movement.
- Improve pedestrian safety by segregating local and through traffic.
- Enhance travel time reliability and commuter convenience.
- Support economic activity by improving accessibility to commercial hubs along the corridor.

1.6 Project Location and Salient Features

The Project road from Sirsi Circle to Nayandahalli on Mysuru Road is located at South West of Bengaluru Location of Project Road is shown below.

Google Earth image showing the Project Road



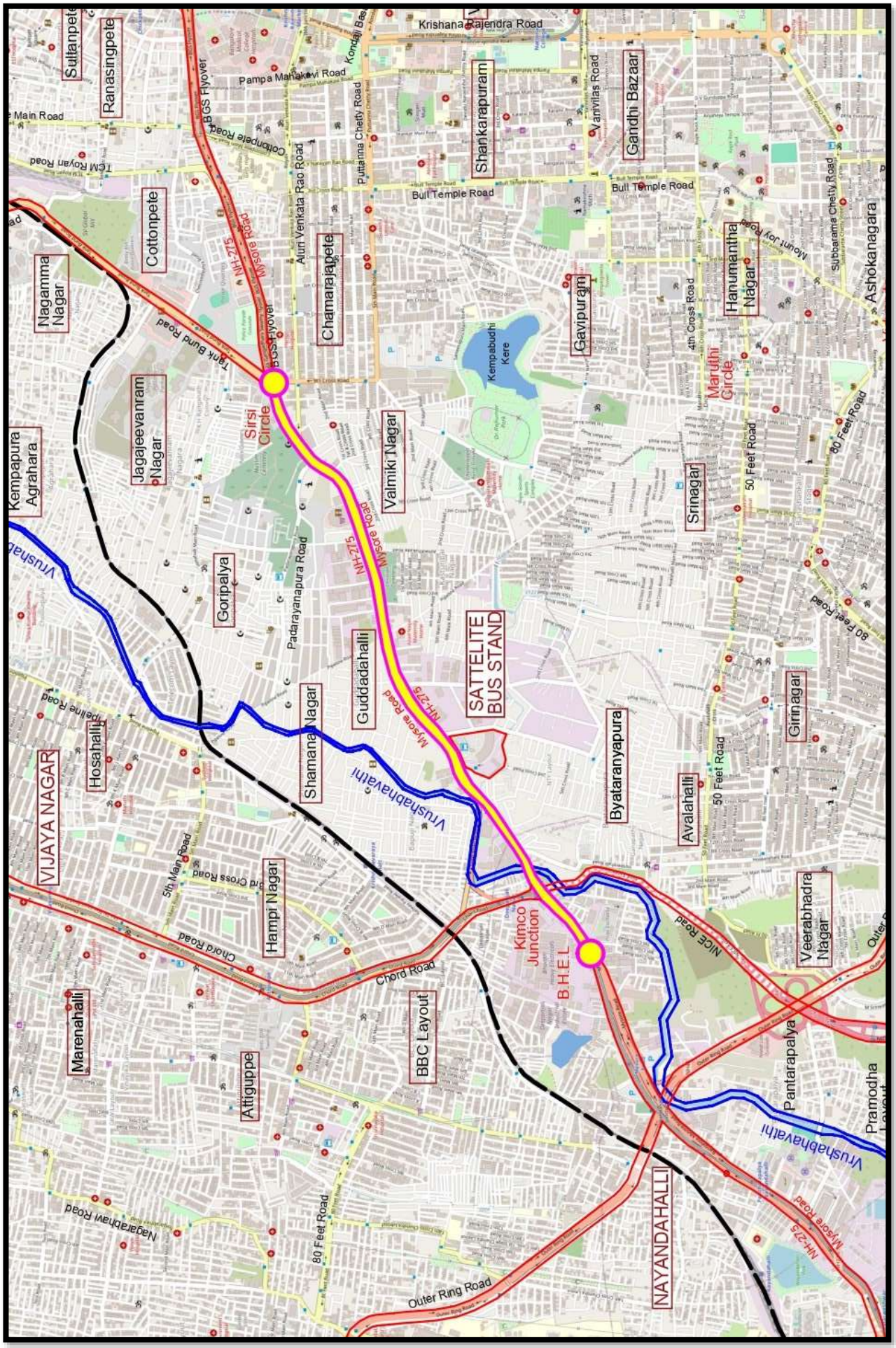


Figure 1-1 Route Map Showing Location of Project Road

Salient Features

Description	Details
Name of Project	Construction of Proposed Elevated Corridor from **Sirsi Circle to Nayandahalli on Mysuru Road**
Budget Head	1. Brand Bengaluru 2. Budget 2025–26, Dated: 7th March 2025, Urban Development, Sl. No. 283 (ii), Page No. 79 3. Subject No. 448/2024–25
Assembly Constituency	1. Chamarajapet 2. Vijayanagara
Parliamentary Constituency	1. Bengaluru Central 2. Bengaluru South
Corporation Limit	1. Bengaluru Central City Corporation 2. Bengaluru West City Corporation
Implementing Authority	**Office of the Director (Technical),** Bengaluru Smart Infrastructure Limited (B-SMILE), #108, 1st Floor, GBA, Annexe–2 Building, N.R. Square, Bengaluru – 560002.
Consultant	Siddi Shakthi Projects, No. 93/31, Asha Nivas, T.G. Layout, Ittamadu, Banashankari 3rd Stage, Hosakerehalli Post, Bengaluru – 560085
Length of Existing Road	4.50 km
Length of Proposed Elevated Corridor (including approaches)	The total length of the proposed elevated corridor is 7.137 km, which includes: • Part of four-lane section • Single-lane section • Ramps When converted to a four-lane equivalent, the effective length is 4.00 km.
Total Project Cost	₹ 810.00 Crores

Description	Details
Amount Put to Tender	₹ 538.28 Crores
Provisions in the Estimate	
GST @ 18%	₹ 96.89 Crores
Contingencies and Provision for Departmental Establishment Charges @ 1% on APT	₹ 5.38 Crores
Independent Engineer / PMC/DPR @ 1.50% on APT	₹ 8.07 Crores
Price escalation @ 2.5% for the 2nd year	₹ 13.45 Crores
Provision for utility shifting @ 8% on APT	₹ 43.06 Crores
Arboriculture/Afforestation @ 0.5% on APT	₹ 2.69 Crores
Land Acquisition Cost including Structures	₹ 101.69 Crores
Miscellaneous and other Departmental Deposits	₹ 0.46 Crores
Total Project Cost	₹ 810 Crores
Cost of Structures in terms of Area / Km	
Total Structural area	Viaduct = 72 156.40 Sqmt Approach = 4,405.00 Sqmt **Total = 76561.40 Sqmt**
Cost / Sqmt	₹ 64,288.00
Cost / Sqmt on APT	₹ 74,600.00
Cost / Sqmt on TPC	₹ 1,12,257.00
Cost / Km on APT	₹ 79.79 Crore
Cost / Km on TPC	₹ 120.07 Crore

Description	Details
Project Duration	24 Months (Including Monsoon)
Schedule of Rates	Common Schedule of Rates 2023-24, Issue Rate for 2025-26, Dated: 08-10-2025 & 06-01-2026.
Area Weightage	10% is adopted as per Schedule of Rates PWD 2023-24 within GBA limit.
Overhead Charges	10% is adopted for concrete work as per Schedule of Rates PWD 2023 - 24 Volume - 1 for Bridge work.
Major Connecting Road	1. Tank Bund Road 2. Sirsi Road 3. Old Guddadahalli Road 4. Pipeline Road 5. Hosakerehalli Road 6. Chord Road 7. NICE Road / Deepanjali Nagara 8. Outer Ring Road
Existing Public facility	1. K.R. Market 2. Satellite Bus Stand (B.M.T.C & K.S.R.T.C) 3. Deepanjali Nagara Metro Station 4. Mysuru Road Metro Station
Ward No. and Name	1. 140 - Chamarajapete 2. 136 – Jagajeevanram Nagara 3. 141 – Azad Nagara 4. 157 – Gali Anjaneya Temple 5. 134 – Bapuji Nagara 6. 133 – Hampi Pura 7. 158 – Deepanjali Nagara
District	Bengaluru Urban
Taluk	1. Bengaluru North 2. Bengaluru South
Hobali	1. Kengeri 2. Kasaba
Revenue Villages	1. Bogenahalli 2. Karithimmanahalli

Description	Details
	3. Byatarayanapura 4. Devatige Ramenahalli
Type of Soil	Sandy Clay
Climate	Temperature - 28^{O} to 32^{O} Humidity - 60 % Wind Speed - 19 Kmph Rain Fall - 970mm
Seismic Zone	Zone II (Least Active Zone)
Survey of India Topo Sheet No.	New No. D43X9 and Old No. 57 H/9
RMP – 2015 map No.	2.01 map (b) - Kempapura Agrahara
Existing RoW width	30 to 35m
Width as per RMP-2015	30 to 45m
Design considerations	Design speed - 30 to 40 kmph Design traffic - 10 msa Design life - 100 years Design CBR - 10 %
Lead Location	Anjanapura Quarry, Total Distance from center of Project alignment to Anjanapura Quarry is 18.00 Km
Total Length of Existing Road	4.50 Km as per Survey
No of Cross Roads	43 Nos (RHS & LHS)
No of Traffic Signals	7 Nos
No of Bus Stops	15 Nos
Traffic Capacity	The present peak hour traffic / hour is estimated for this project is 70569 and 142880 is estimated for next 25 years i.e. at 2050.
Number of Lane	4 lanes Bidirectional / 20.2m width
Minimum Main Carriageway Width	2 x 7.5 m
Merging/Diverging Tapering length	200m
Merging/Diverging loop lane width	Intermediate lane of 7m with a configuration of 5.5m CW + 2 x 0.25m shy off + 2 x 0.5m Crash barrier

Description	Details
Minimum Vertical Clearance	5.5m (Varies as per site condition for LCV)
Viaduct Span for straight reach	45m for 20.2m /8.5m/7.0m Carriage Way
Viaduct Span at Curve location	35m for 20.2m /8.5m Carriage Way
Pier cap at restricted CW width for 7/8.5m width of flyover	Cantilever Type
Vertical clearance for second level structure	4.5m / 5.5m
Supporting structure at split section / wider	Portal frame with UHPFRC I Girder as beam
Type of Box Girder	Segmental UHPFRC U Girder for 8.5m and strutted Box Girder for 20.2m PSC Pier Cap for 8.5m and 20.2m.
Foundation	Deep Pile foundation
Entry / Exit Ramp	With RE Wall approach
Additional provisions in corridor	1. End to End Connectivity 2. Entry and Exit at suitable locations 3. Installation of Flexible Median at regular interval for traffic diversion during emergency. 4. Installation of Variable Message Signs (VMS) to manage traffic and provide real time information to the road users. 5. Installation of automatic traffic count machine. 6. Integrating existing and ongoing flyover for Entry/exists
At grade improvement	The restoration of White thin topping and reconstruction of CC pavers along with foot path pavers is included in the estimate. Apart from this reconstruction of road on approaches and widening is proposed wherever necessary and additional provision for overlay of 40mm Bituminous Concrete (BC) and 60mm of Dense Bituminous Concrete (DBM) used for profile correction to correct the undulations including desilting of the existing drain with repairs at damaged locations. Apart from this new construction of road for 1.50 Km is considered in the estimate for providing service road on approaches at NICE Road, BHEL Junction, Kudhure Park and Sirsi Circle adjoining to Police Housing property.
Utility relocation	Utilities such as Water Supply and sewage lines (BWSSB), High Tension Power Line of 11 KV (BESCOM / KPTCL), GAS Pipeline/OFC are found in the corridor. After consultation with concerned stake holders a lump sum provision of 8% on the cost of Amount put to tender is reserved for shifting/reconstruction of Utilities falling within the project corridor.

Proposed Elevated Corridor
(Details of Length)

Sl. No.	Description	Chainage		Length in Km	Width in m
		From	To		
1	Proposed loop of Single Lane Flyover from existing Balagangadharanatha Swamy Flyover to Kudhure Park (LHS) including merging Tapering length. Length of Viaduct = 968m	0+000	0+968	0.968	8.50
2	Proposed loop of Intermediate Lane from existing Balagangadharanatha Swamy Flyover to Kudhure Park (RHS) including Tapering length of diverging / Merging. Length of Viaduct = 968m	0+000	0+968	0.968	8.50
3	Proposed intermediate Lane from Gopalan Mall to Sirsi Circle (RHS) Length of Approach=65m, Length of Viaduct=473m	0+430	1+968	0.538	7.00
4	Proposed 2 Lane Flyover approach from Kudhure Park to Gopalan Mall (LHS) Length of Approach = 100m, Length of Viaduct = 100m	0+695	0+895	0.200	8.50
5	Proposed 4 Lane Flyover from Gopalan Mall to Gali Anjaneya Temple to BHEL Junction near Vrishabhavati River Bridge Length of Viaduct = 1822m	0+968	2+790	1.822	20.20
6	Proposed tapering intermediate Down Ramp near Bytarayanapura Police Station to BHEL Junction near Vrishabhavati River Bridge Length of Approach = 100m, Length of Viaduct = 250m	2+405	2+755	0.350	7.00
7	Proposed 2 Lane Flyover from BHEL Junction near Vrishabhavati River Bridge to Existing Nayandahalli Flyover (Indian Oil Petrol Bunk) Length of Approach = 100m, Length of Viaduct = 560m	2+790	3+450	0.660	8.50
8	Proposed 2 Lane Up Ramp from K.S.R.T.C Bus Depot No. 5 to BHEL Junction near Vrishabhavati River Bridge Length of Approach = 100m, Length of Viaduct = 170m	0+000	0+270	0.270	8.50
9	Proposed 2 Lane Up ramp Loop from Vijayanagara to Proposed Flyover near Sri Gali Anjaneya Swami Temple Junction Length of Viaduct = 460m	0+000	0+460	0.460	8.50
10	Proposed intermediate loop lane Flyover from BHEL Junction to NICE Road Length of Approach = 100m, Length of Viaduct = 410m	0+00	0+510	0.510	7.00
Total length of Elevated Corridor				**6.746 Km**	
Total length of Approach				**565.00m**	
Total Length of Viaduct				**6181.00m**	
Total area of Viaduct				**72156.40Sqm**	
Total Area of Approach				**4405.0Sqm**	
Total Area including Viaduct & Approaches				**76561.40Sqm**	

Design standards and other references

- IRC: 5 General Features of Design.
- IRC: 6 Loads and Stresses.
- IRC: 15 Construction of Concrete Roads.
- IRC: 18 DESIGN Criteria for Pre-Stressed Concrete Road Bridges (Post-Tensioned Concrete).
- IRC SP 19 Manual for Survey, Investigation and Preparation of Road Projects.
- IRC: 21 Standard Specifications and Code of Practice for Road Bridges.
- IRC: 22 Composite Construction (Limit State Design).
- IRC: SP: 23 Vertical Curves for Highways.
- IRC: 24 Steel Road Bridges.
- IRC: 35 Road Markings.
- IRC: SP: 37 Guidelines for Evaluation of Load Carrying Capacity of Bridges.
- IRC: 37 Design of Flexible Pavements.
- IRC: 38 Design of Horizontal Curves for Highways and Design Tables.
- IRC: 39 Standards for Road-Rail Level Crossing (I Revision).
- IRC: SP: 42 Road Drainage.
- IRC: 44 Cement Concrete Mix Design for Pavements.
- IRC: SP: 50 Urban Drainage.
- IRC: 54 Lateral and Vertical Clearances at Underpasses for Vehicular Traffic.
- IRC: SP: 56 Steel Pedestrian Bridges.
- IRC: SP: 57 Quality Systems for Road Construction.
- IRC: 58 Design of Plain Jointed Rigid Pavements for Highways.
- IRC: 65 Recommended Practices for Traffic Rotaries.
- IRC: 67 Road Signs.
- IRC: 71 Abbreviations and Symbols in Documents and Plans.
- IRC: 78 Foundation and Substructure.

- IRC: 79 Road Delineators.
- IRC: 83 (Part I) Metallic Bearings.
- IRC: 83 (Part II) Elastomeric Bearings.
- IRC: 83 (Part III) POT, POT cum PTFE, PIN and Metallic Guide Bearings.
- IRC: 86 Geometric Design Standards for Urban Roads in Plains.
- IRC: SP: 90 Manual for Grade Separators and Elevated Structures.
- IRC: 92 Designs of Interchanges in Urban Areas.
- IRC: 103 Pedestrian Facilities.
- IRC: 112 Concrete Road Bridges.
- IS: 2911 (All Parts) Pile Foundations.
- Designs and drawings of Flyover from Indora Chowk to Dighori Chowk in Nagpur (NHAI).
- Circular for use of UHPFRC by MORT&H, Government of India, File No. RW/NH-33049/101/2020-S&R(B) Pt, Dated 22-02-2022.
- Guideline for use of UHPFRC [File No. RDSO-BNSOESTR (CB-1)/5/2020-O/o ED/Structures/RDSO, Dated: 08-0-2024 (CBS/PCB report No. BS-136),] by Ministry of Railway, Government of India, Research Design and Standards organization, Lucknow-226011.
- Comprehensive Mobility plan.
- Survey of India Topo sheets
- Survey of India GTS Bench Mark.
- References of other similar projects.
- PWD Common schedule of Rates Karnataka 2025-26, Issue Rate Dated: 06-01-2026
- PWD SoR for Road and bridge Work, Government of Madhya Pradesh 11-04-2025.
- Final Feasibility Study Report, November 2024, Volume-I & 2, Altinok.
- Normative cost of Ministry of Road Transport and Highways (EAP) Zone, Government of India No: RW/NH-24036/272010-PPP, Dated: 25-04-2018 (11 pages) & 19-01-2022 (23 pages).

- Guideline Value of Bengaluru Urban District under Jayanagara Circle (CVC/99/2023-24, Dated:08-09-2023)
- Central Public Works Department (CPWD) Plinth Area Rates of 2025.

Benefits of this Project

- **Reduced Travel Time & Delays – Faster and more reliable movement along the corridor.**
- **Congestion Relief** – Diverts through traffic above grade, easing surface-level pressure.
- **Improved Level of Service** – Enhances efficiency and comfort for commuters.
- **Lower Fuel Consumption & Pollution** – Reduced idling and stop-and-go movement improve air quality.
- **Reduced Vehicle Operating Costs** – Less wear and tear, lower maintenance expenses.
- **Minimized Junction Delays & Conflicts** – Smooth flow across critical intersections.
- **Enhanced Connectivity** – Better access to adjacent residential, commercial, and transit hubs.
- **Capacity for Future Demand** – Designed to accommodate projected traffic growth.
- **Urban Regeneration Opportunities** – Supports redevelopment and revitalization of Surrounding areas.
- **Transit-Friendly Environment** – Encourages integration with sustainable public Transport.
- **Seamless Multimodal Transfers** – Easier shift between metro, bus, and private modes.
- **Commercial Potential** – Unlocks land value capture and integrates existing Retail/commercial clusters.
- **Redevelopment Integration** – Ensures rehabilitation or relocation of existing uses within The scheme.

1.7 Existing Project Road Details

The proposed project corridor from Sirsi Circle to Nayandahalli on Mysuru Road. As this route connects Mysuru Express Way being National Highway 275. This route is major traffic in Bangalore that experiences significant congestion, especially during peak hours. This route connects South West of Bangalore, passing through key commercial and residential areas, including the factors contributing to congestion:

Road Inventory

As stated above, the total length of the project road is 4.50 km. along this stretch, there are 43 cross roads (RHS & LHS), including 7 major junctions with traffic signals. Approximately 15 bus stops (RHS & LHS) are located along the corridor. From chainage 0+000 to 3+200, the carriageway has been improved with white-topping.

The existing footpath width varies between 2.20 m and 4.50 m, while the RCC drain width ranges from 1.20 m to 2.00 m, positioned almost at the edge of the existing carriageway.

A detailed chainage-wise description of the project corridor is provided in the table below for better understanding of the project road.

Sl. No.	Chainage	Foot Path width in m	Carriageway Width in m	Median	Carriageway Width in m	Foot Path width in m	EROW Width in m	RMP No. and Name	Width as per RMP-2015 in m
1	0	2.20	17.30	0.80	15.70	2.40	38.40	2.01 Map (b) Kempapura Agrahara	30
2	50	2.70	15.70	1.00	18.90	3.20	41.50		30
3	100	2.30	15.90	1.00	14.70	2.90	36.80		30
4	150	2.70	11.90	1.00	15.60	4.50	35.70		30
5	200	3.60	28.60	-	-	4.10	36.30		30
6	250	2.10	10.10	1.10	13.80	3.50	30.60		30
7	300	2.90	10.20	0.90	10.80	2.40	27.20		30
8	350	2.10	11.00	1.20	10.70	2.10	27.10		30
9	400	1.90	11.60	1.00	11.10	2.60	28.20		30
10	450	2.00	12.60	1.10	12.00	4.20	31.90		30
11	500	2.30	23.20	1.00	11.40	4.30	42.20		30
12	550	2.10	12.10	1.10	11.00	4.30	30.60		30
13	600	2.10	11.80	1.10	10.70	2.80	28.50		30
14	650	2.10	11.60	1.10	10.70	1.10	26.60		30
15	700	1.70	23.20	-	-	3.30	28.20		30
16	750	1.70	10.80	0.70	10.30	3.00	26.50		30
17	800	1.10	9.90	0.60	11.40	3.10	26.10		30
18	850	1.20	10.40	0.60	11.80	2.00	26.00		30
19	900	0.70	10.30	0.60	11.10	4.00	26.70		30
20	950	3.70	10.70	0.60	11.10	4.30	30.40		30

Sl. No.	Chainage	Foot Path width in m	Carriageway Width in m	Median	Carriageway Width in m	Foot Path width in m	EROW Width in m	RMP No. and Name	Width as per RMP-2015 in m
21	1000	3.90	11.10	0.80	10.90	3.30	30.00	2.01 Map (b) Kempapura Agrahara	30
22	1050	4.50	10.60	0.70	10.70	3.40	29.90		45
23	1100	2.10	12.40	0.70	10.60	3.30	29.10		45
24	1150	3.40	11.80	0.60	10.80	3.00	29.60		45
25	1200	3.50	11.60	0.90	13.70	4.80	34.50		45
26	1250	3.70	11.20	0.60	13.80	7.00	36.30		45
27	1300	3.80	10.50	0.60	14.60	3.30	32.80		45
28	1350	4.20	9.90	0.50	9.90	2.30	26.80		45
29	1400	2.10	15.30	0.70	12.90	2.10	33.10		45
30	1450	2.50	15.90	0.70	16.00	2.20	37.30		45
31	1500	3.10	14.80	0.70	13.70	2.10	34.40		45
32	1550	3.20	15.20	0.80	13.80	2.20	35.20		45
33	1600	4.20	15.30	0.70	14.20	2.50	36.90		45
34	1650	5.60	24.50	-	-	3.20	33.30		45
35	1700	-	11.50	0.70	11.00	3.10	26.30		45
36	1750	3.90	12.10	0.80	11.30	4.20	32.30		45
37	1800	-	16.50	0.80	12.00	2.60	31.90		45
38	1850	2.10	13.10	0.70	12.70	1.90	30.50		45
39	1900	2.10	10.90	0.70	13.60	2.10	29.40		45
40	1950	2.10	13.60	0.70	14.60	1.40	32.40		45
41	2000	-	16.60	0.80	11.40	-	28.80		45
42	2050	1.80	15.40	-	-	-	17.20		45
43	2100	2.00	14.10	-	-	2.00	18.10		45
44	2150	2.00	15.20	1.80	-	-	19.00		45
45	2200	2.10	14.10	-	-	3.50	19.70		45
46	2250	-	9.30	2.90	-	3.00	15.20		45
47	2300	-	29.90	-	-	2.80	32.70		45
48	2350	3.40	19.80	-	-	1.40	24.60		45
49	2400	-	23.40	-	-	-	23.40		45
50	2450	-	26.50	-	-	4.60	31.10		45
51	2500	-	55.50	Junction		7.40	62.90		45
52	2550	1.10	7.70	3.60	10.80	6.70	29.90		45
53	2600	1.10	7.90	2.90	15.70	4.60	32.20		45
54	2650	1.10	10.00	3.00	20.60	3.60	38.30		45
55	2700	0.90	10.40	2.90	12.20	1.50	27.90		45
56	2750	0.90	10.90	2.50	10.80	1.50	26.60		45
57	2800	2.20	10.50	2.60	11.60	1.30	28.20		45
58	2850	4.30	10.00	2.50	12.00	1.60	30.40		45
59	2900	4.60	10.60	2.70	12.80	1.30	32.00		45
60	2950	3.20	12.90	1.90	11.40	-	29.40		45
61	3000	1.80	11.70	1.40	13.30	4.10	32.30		45

Sl. No.	Chainage	Foot Path width in m	Carriageway Width in m	Median	Carriageway Width in m	Foot Path width in m	EROW Width in m	RMP No. and Name	Width as per RMP-2015 in m
62	3050	1.80	11.50	1.40	14.90	-	29.60	2.01 Map (b) Kempapura Agrahara	45
63	3100	1.70	16.50	1.00	15.90	1.50	36.60		45
64	3142	2.40	18.80	0.90	17.70	1.60	41.40		45

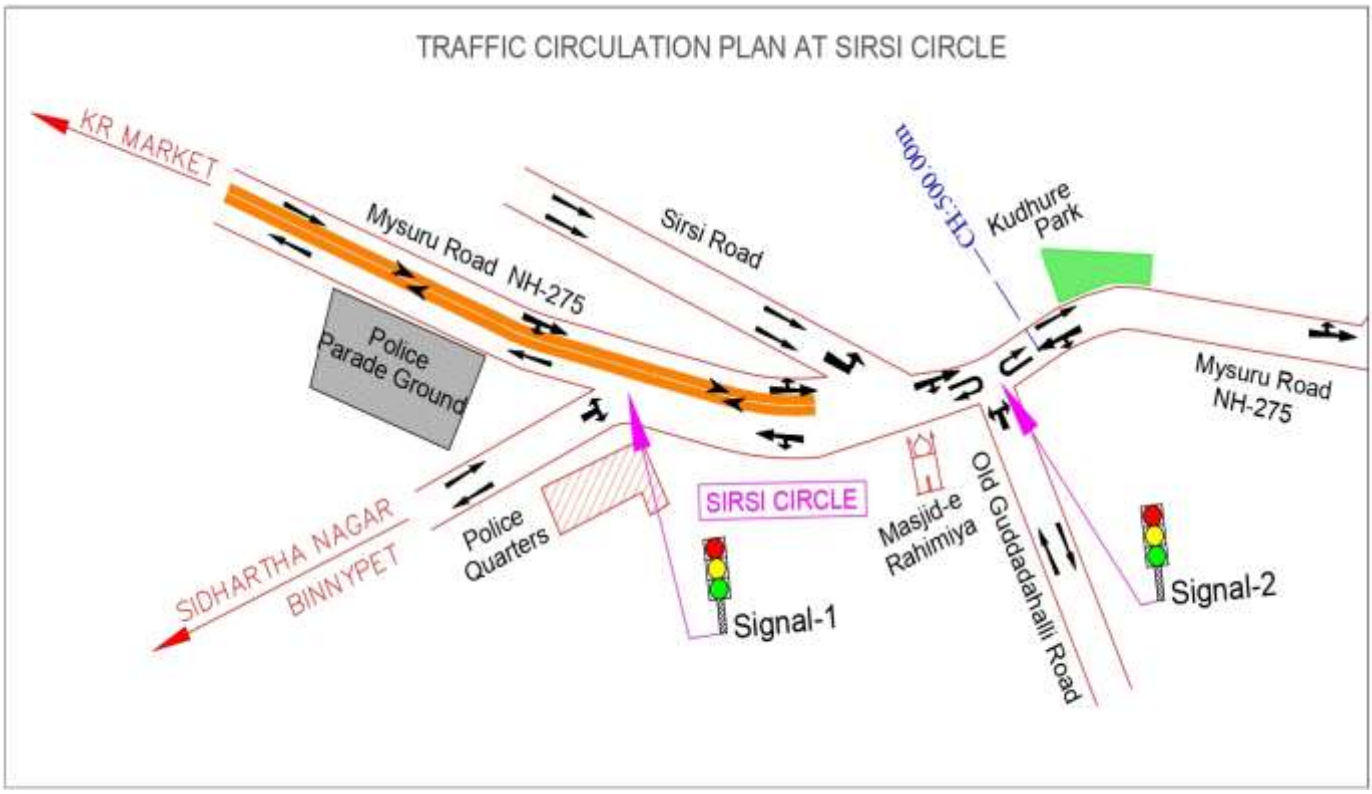
Table 1-1 Project Road Existing Right of Way details

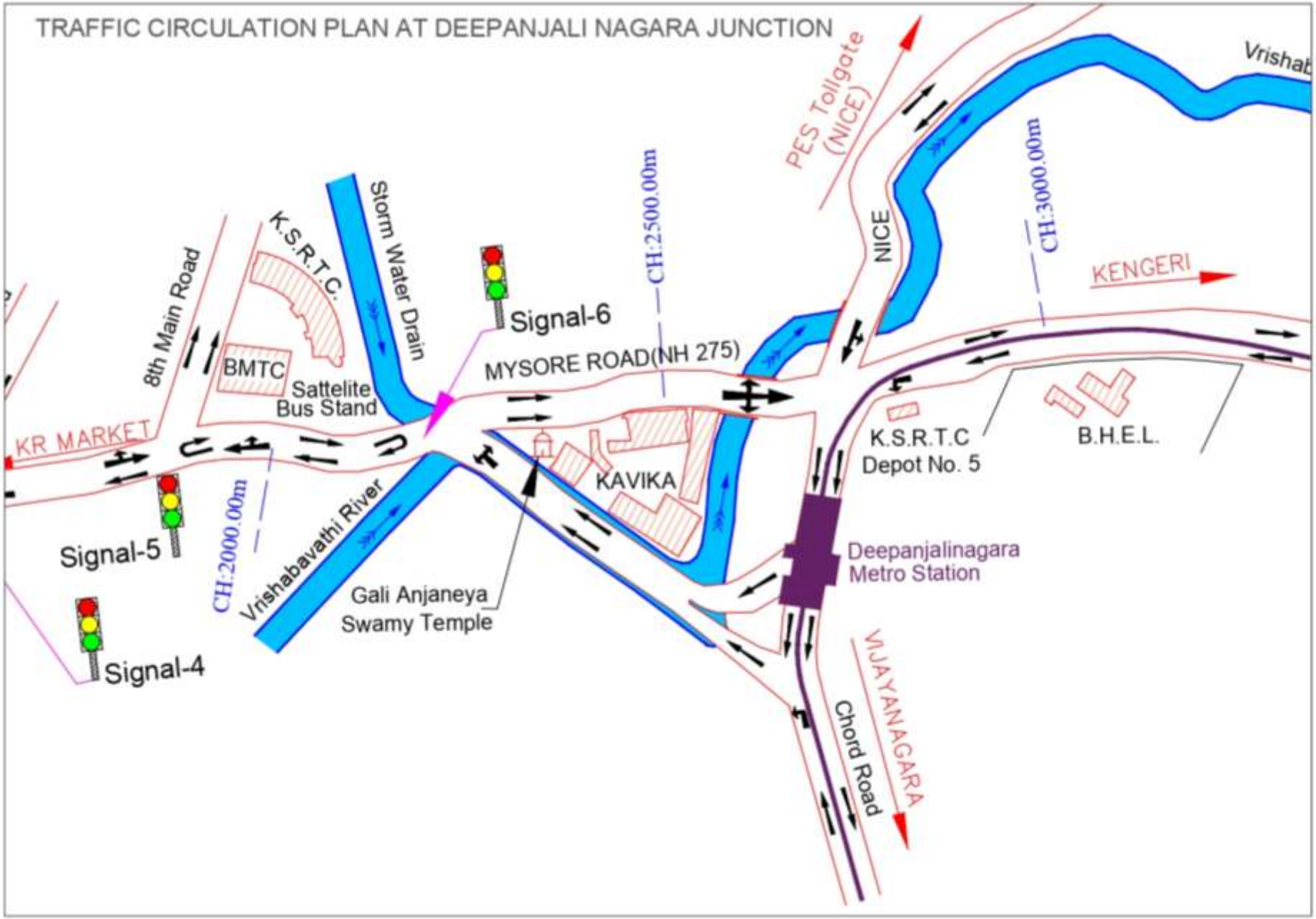
1.7.1 Existing Traffic Circulation flow of the Project Road

The existing traffic circulation along the project road is illustrated in Figure 1.1 and Figure 1.2. These figures depict the current movement pattern of vehicles along the corridor. The circulation includes:

- Direction of traffic flow
- Number of lanes in operation
- Existing intersections and junctions
- Traffic control measures such as signals

Understanding the present traffic circulation is crucial for planning improvements and designing the proposed elevated corridor. It provides the baseline for identifying congestion points, evaluating junction performance, and assessing the need for grade separation and capacity augmentation.




TRAFFIC CIRCULATION PLAN AT DEEPANJALI NAGARA JUNCTION
PES Tollgate (NICE)
Vrishab
NICE
CH:3000.00m
CH:2500.00m
KENGERI
Storm Water Drain
K.S.R.T.C.
8th Main Road
Signal-6
BMTC
Sattelite Bus Stand
MYSORE ROAD(NH 275)
KR MARKET
K.S.R.T.C Depot No. 5
B.H.E.L.
KAVIKA
CH:2000.00m
Vrishabavathi River
Signal-5
Gali Anjaneya Swamy Temple
Deepanjalinagara Metro Station
Signal-4
VIJAYANAGARA
Chord Road

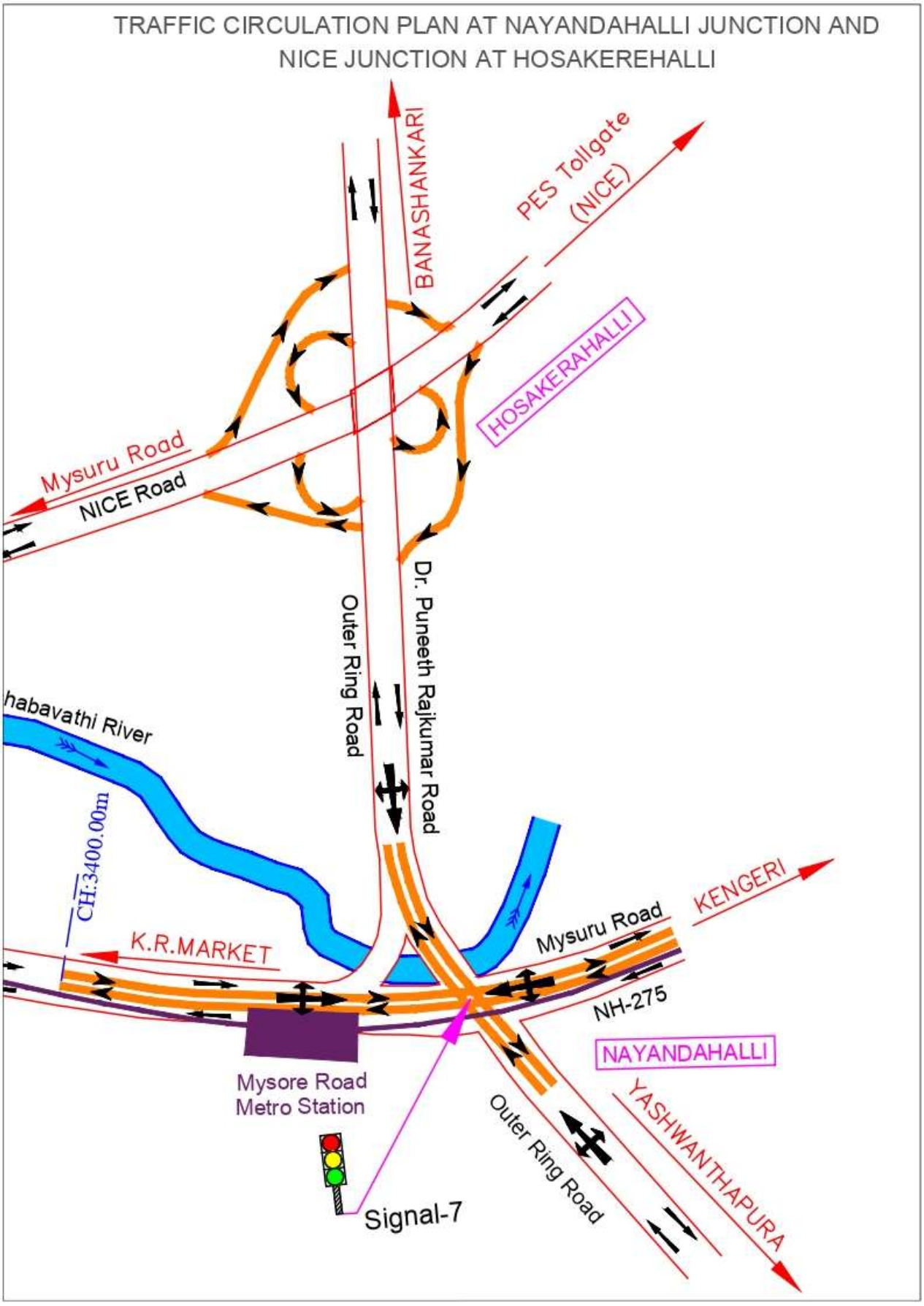


Figure 1-2 Existing Traffic circulation plan of Project Corridor

1.7.2 Seismic Analysis

Seismic Zone: The project site is falling within a Seismically Active Region Zone II (Least activity zone).

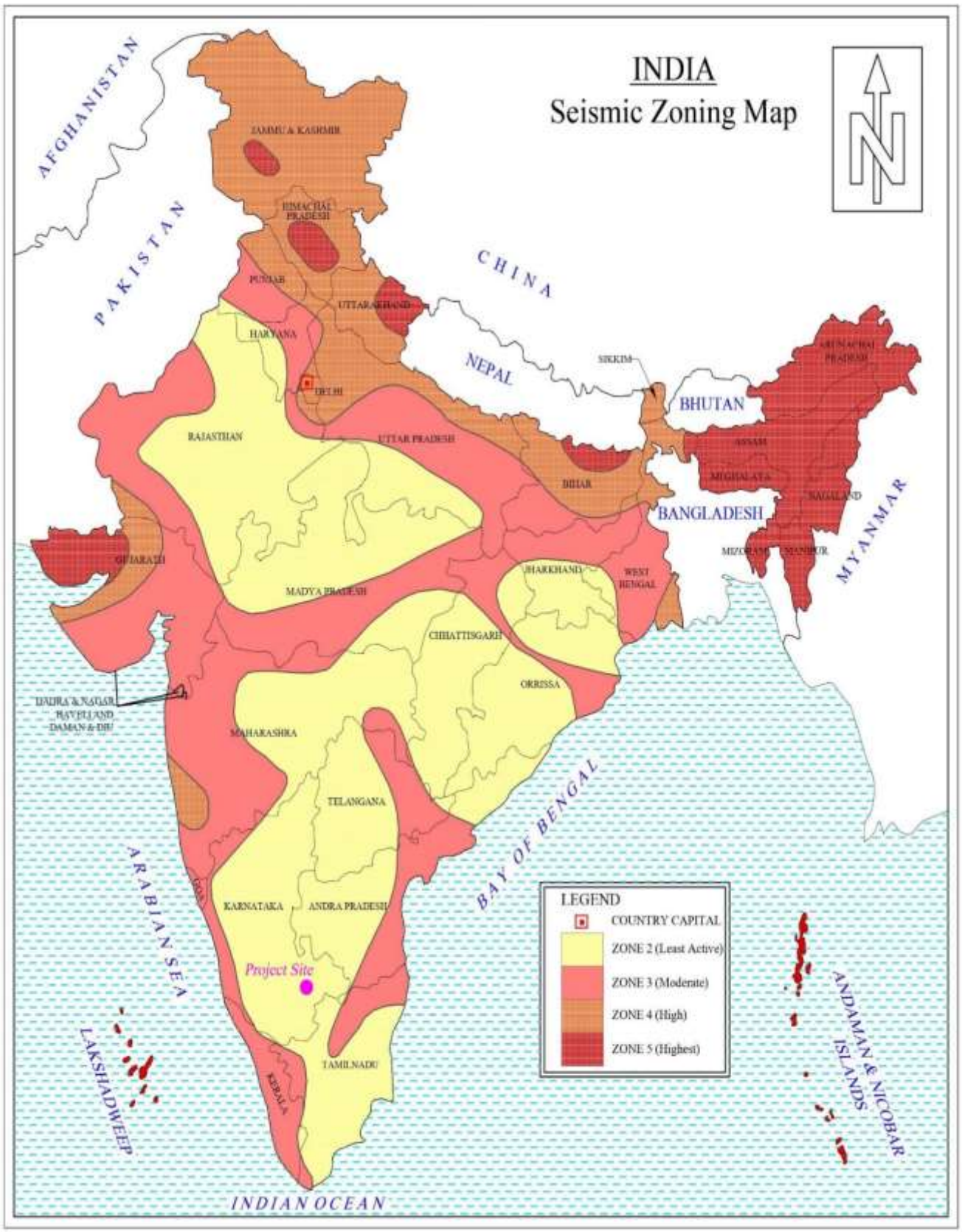


Figure 1-3 Seismic Zone Map

A seismic study would involve investigating the ground's response to seismic waves, which can be used to assess the potential for earthquake damage and guide construction in the area. While Bangalore falls under Seismic Zone II, meaning moderate earthquake risk, a seismic study can help identify areas with higher or lower risk within proposed project corridor.

Seismic Refraction Analysis:

This study use artificial seismic waves to map the subsurface layers and their properties.

- Analyzing how these waves travel through the ground, the study can determine the depth and characteristics of soil and rock layers, which can affect how they respond to earthquakes.
- This information can be crucial for understanding the potential for ground shaking and liquefaction in different parts of Proposed Project corridor.

Seismic Micro Zonation Analysis

Seismic micro zonation involves dividing an area into smaller zones based on factors like soil type, topography, and geological structure.

- Study helps to identify areas within Proposed Project corridor that might be more vulnerable to earthquake damage than others.
- For instances, areas with soft soil or unstable slopes might be identified as higher risk zones.

Ground Motion Analysis

- This studies analyze how seismic waves propagate through the ground and how they affect buildings and structures.
- This helps to estimate the ground shaking intensity in different parts of Proposed Project corridor during an earthquake.
- The results of these studies can be used to develop building codes and construction guidelines that are appropriate for the local seismic conditions.

Necessity of Seismic Analysis

- This seismic study can provide valuable information for making informed decisions about construction and infrastructure development in Proposed Project corridor.
- Understanding the local seismic conditions, it is possible to mitigate the risks associated with earthquakes and ensure the safety of buildings and people.

1.7.3 Revised Master Plan (RMP-2015

We have collected RMP - 2015 map for the Proposed Project Road section and marked the project road in the RMP-2015. The details of RMP - 2015 map No. width of Existing Road width as per RMP - 2015 are shown already in the above table.

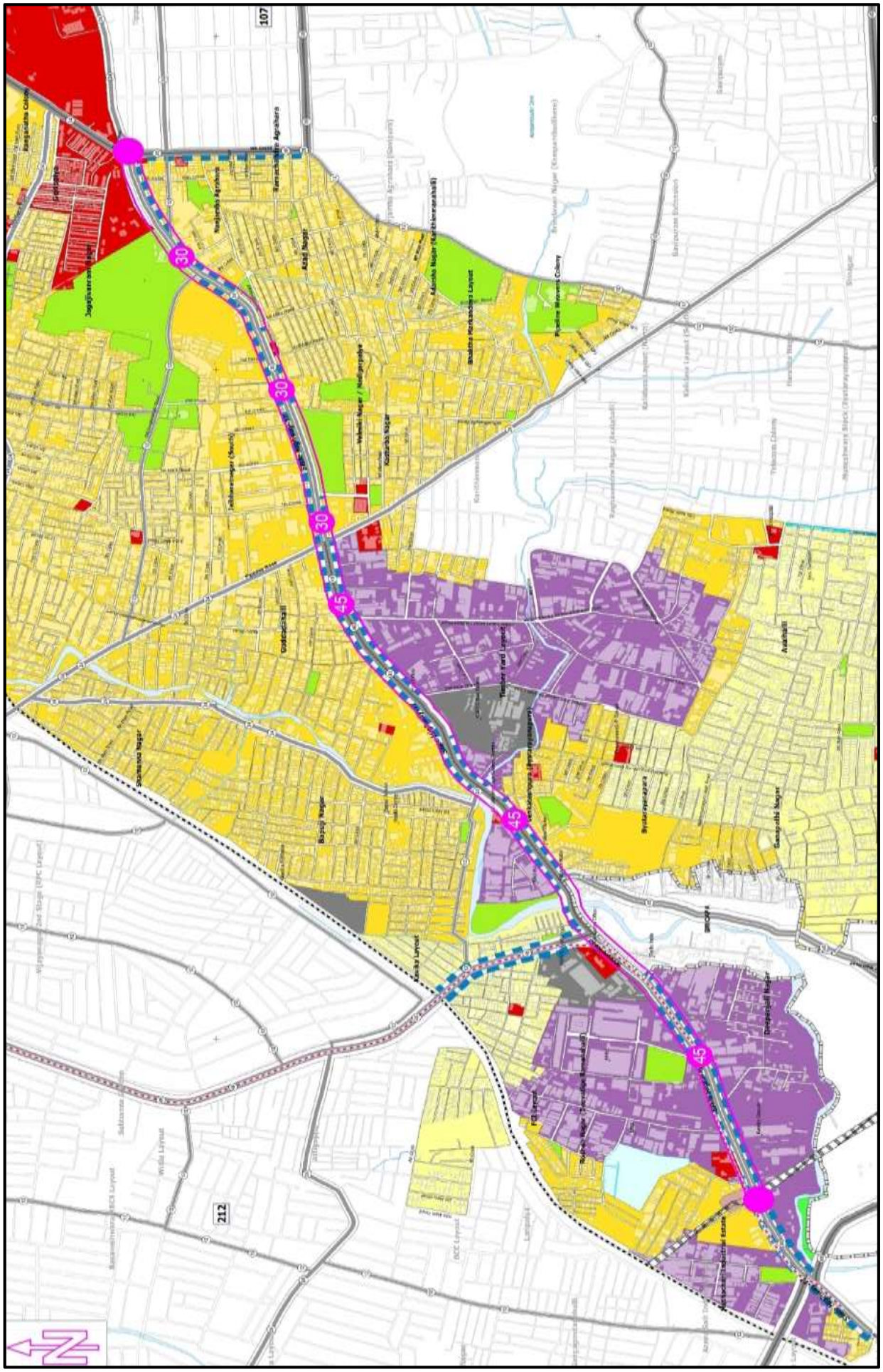


Figure 1-4 RMP-2015 Map Showing the Project Road

1.7.4 Project Jurisdiction

The jurisdictions of the project corridor, such as parliamentary, assembly, zone and ward, are identified with chainge are as shown table below (Table 1-2).

Sl. No.	GBA Corporation Limit	Assembly Constituency	Parliamentary Constituency	Ward no and Name	Chainage in m	
					From	To
1	Bengaluru Central city corporation	Chamrajpet	Bengaluru Central	47-IPD Salappa Ward	0.00	265.00
2				48 - Azad Nagar	0.00	938.00
3				50- Jagajeevanram Nagar	275.00	1342.00
4				49- Kasturabha nagar	938.00	1342.00
5	Bengaluru West city corporation	Vijayanagar	Bengaluru South	89 - Bapuji Nagara	1342.00	2180.00
6				92- Muneshwar Block	1342.00	1575.00
7				91- Gali Anjaneya Swamy Tmeple	1575.00	2700.00
8				93- Avalahalli	2650.00	2800.00
9				94 - Deepanjali Nagar	2600.00	3284.00

Table 1-2 Jurisdiction of the Project Road

1.7.5 Revenue Villages

There are 12 revenue villages on the project road, which are listed in Table 1-3 below.

Sl. No.	District	Taluk	Hobali	Village
1	Bengaluru Urban	Bengaluru North	Kasaba	Bogenahalli
2				Karithimmanahalli
3				Byatarayanapura
4		Bengaluru South	Kengeri	Deevatige Ramanahalli

Table 1-3 Revenue Villages of the Project Road

1.8 Objective of the Project

The key objectives of the study are as follows:

Assessment of Need – Evaluate the requirement for elevated road infrastructure along the project corridor, identify prevailing traffic problems, and ensure seamless travel in terms of connectivity, safety, and convenience.

Conceptual & Detailed Planning – Develop a detailed conceptual design and prepare the Detailed Project Report (DPR) to support the client in effective project implementation.

Mobility Enhancement – Propose actionable measures and conceptual-level designs to improve mobility along major corridors.

The elevated roads are being constructed along arterial routes in Bengaluru primarily to alleviate traffic congestion and improve overall mobility. By providing a separate, elevated roadway, these

projects aim to segregate long-distance commuter traffic from local traffic, thereby enhancing overall corridor capacity.

Additionally, elevated corridors can:

- Prioritize public transport movement.
- Encourage a shift towards sustainable mobility solutions.
- Improve travel reliability and safety.
- Support long-term urban growth and economic activity.

The following sections provide a detailed overview of the advantages of constructing the elevated corridor from Sirsi Circle to Nayandahalli:

1.8.1 Advantages of the Proposed Project

a) Reduced Congestion

Elevated corridors are designed to accommodate heavy traffic flows on sub-arterial roads, particularly during peak hours, by providing additional capacity and enabling faster vehicle movement.

b) Improved Public Transport

The project aims to prioritize the movement of public transport vehicles, ensuring faster and more efficient services, thereby encouraging commuters to shift from private to public modes.

c) Augmented Road Capacity

Elevated roads add significant capacity to existing arterial corridors, allowing smoother traffic flow and reducing bottlenecks at critical junctions.

d) Enhanced Safety

By segregating traffic streams, elevated corridors reduce conflict points and minimize accident risks, creating a safer environment for both vehicles and pedestrians.

e) Sustainable Mobility

Reduced reliance on private vehicles and improved accessibility to public transport contribute to a more sustainable and transit-friendly urban transport system.

f) Economic Growth

Improved connectivity and reduced travel time stimulate economic activity, enhance productivity, and support regional growth.

g) Environmental Benefits

Better traffic flow and reduced idling lower fuel consumption, decrease emissions, and improve air quality along densely populated stretches.

1.9 Tender for Design Consultancy Services

The consultancy services for the preparation of the Detailed Project Report (DPR) for the construction of the proposed elevated corridor from Sirsi Circle to Nayandahalli Junction have been awarded to M/s Siddi Shakthi Projects. The scope of this consultancy is limited to DPR preparation and tender processing for civil construction works.

It is important to note that this report is intended solely for conceptual planning and tender documentation purposes and shall not be referred to for detailed engineering or execution-level designs.

1.10 Objective of the Study

The primary objectives of the study are:

1. **Engineering Surveys & Investigations:** Conduct necessary engineering surveys and investigations to develop an innovative corridor design.

2. **Optimal Land Utilization:** Propose a scheme in line with Indian Road Standards, ensuring maximum use of available open land and minimizing acquisition of private property.

3. **Modern & Economical Design:** Implement the project by adopting modern concepts of innovative structural design, with emphasis on speed of construction and cost efficiency.

4. **Cost Estimation & Tender Documentation:** Prepare accurate cost estimates and comprehensive tender documents to facilitate project implementation.

1.11 Project Scope

The scope of the consultancy study involves the following:

1) Conducting Joint site inspection along with Departmental Engineers for understanding the name of road, starting, ending location of the project road and Requirements of the project.
2) Conducting Detailed Topographical survey, implementing Drone Technology and preparation and submission of final Auto CADD format Drawing showing Existing Right of Way (EROW) and Proposed Right of Way (PROW).
3) Review and study of Geotechnical Investigation.
4) Conducting Traffic Survey
5) Preparation of GAD for Project Road
6) Preliminary Structural design as per IRC Standards,
7) Preparation of Road alignment and design
8) Preparation of Estimate as per States schedule of rates

9) Preparation of Tender document for inviting tender for construction of Elevated road and related works.
10) Coordinating with Sub-Urban Rail to finalize location of piers to minimize impact on rail movement.

Detailed Project Report including above scope of work has been prepared as part of the scope.

1.12 Broad Methodology

The following broad methodology has been adopted in the present study to arrive at a viable solution for an innovative design at the railway crossing, with the objective of improving traffic flow from all directions:

1. **Traffic Flow Analysis**

Study the existing traffic circulation and anticipate future traffic demand along the corridor.

2. **Integration with Future Plans**

Review proposed developments such as Metro expansion, Suburban Railway planning, and BDA/GBA proposals to ensure coordinated planning.

3. **Adoption of Innovative Technology**

Explore modern construction technologies, including rapid construction methods and recent advancements in pre-cast structural systems, to minimize traffic disruption during execution.

4. **Road Design Improvements**

Prepare conceptual designs aimed at enhancing traffic movement and reducing congestion.

5. **Quantity & Cost Estimation**

Develop detailed quantity calculations and cost estimates for the widening and improvement scheme.

The detailed methodology adopted for the project is illustrated in a line diagram (Figure 1-5) is shown below for better understanding.

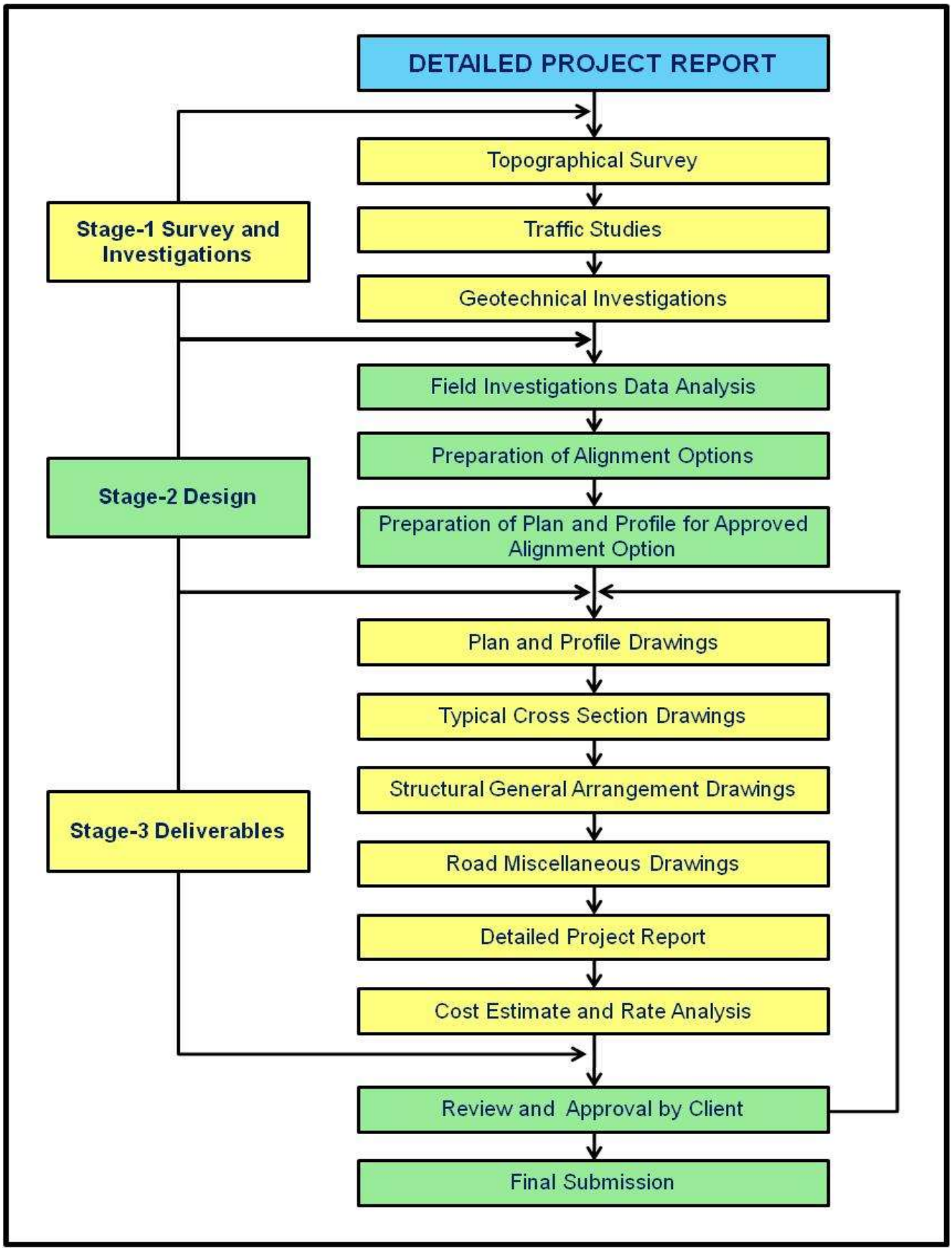


Figure 1-5 Line diagram showing the Methodology of study

1.13 Deliverables

As part of a detailed project report, the following are proposed to be submitted according to TOR's reporting.

VOLUME - I: Main Report

I. Detailed Project Report

1. Key Features and Summary of the Project Report

2. Introduction

3. Surveys and Investigations

4. Improvement Proposals and Design Standards

5. Design Report

6. Design Drawings

7. Project Cost

II. Detailed Estimate

III. Tender Documents

IV. Technical Specifications

VOLUME -II: Drawings

2 Survey and Investigation

2.1 General

Various engineering surveys have been undertaken to ensure proper planning and design of the proposed elevated corridor. The following surveys have been carried out:

- Topographical Survey
- Traffic Survey
- Geotechnical Investigations for Foundations

As part of the study, the consultants visited the site along with officials from Bengaluru Smart Infrastructure Limited (BSMILE), accompanied by the concerned Executive Engineer and his team. The purpose of the visit was to familiarize themselves with the site conditions and to examine various constraints that must be considered while preparing alternative solutions for junction improvement.

2.2 Reconnaissance Survey

A Reconnaissance Survey was carried out as an initial, broad assessment of the study area to gather preliminary information and identify potential constraints and opportunities. This survey is a crucial first step in engineering and infrastructure planning, helping to determine feasibility and guide further detailed investigations.
The detailed ground reconnaissance and primary tasks undertaken during the survey included:

- Topographical features of the area.
- Physical features in the proposed road within and outside PROW.
- Preliminary identification of traffic pattern.
- Soil (textural classifications).
- Type and extent of existing utility services along the alignment (within PROW).
- Geology of study area.
- Seismic Zone.
- Collection of Storm Water Drain details along the project alignment.
- Collection of Topo map of project alignment from Survey of India.
- Collection of GTS Bench Mark details in project alignment.
- Collection of rainfall and flood data.
- Sources of construction material.
- Site Photos.

The data collected during the reconnaissance surveys were utilized for planning and programming detailed surveys and investigations. All subsequent field studies, including traffic surveys, were undertaken based on the preliminary information derived from the reconnaissance stage.

Detailed measurements were recorded at 50 m intervals along the existing road and proposed alignment, and levels were established across the study area. In addition, sufficient site photographs were captured during the site visits and have been annexed to this report for reference.

2.2.1 Data collection for Topographical survey

Before commencing the survey work, the required primary data was collected from the relevant departments. Based on this information, the topographical survey was carried out in a systematic manner. The following survey data was collected: An image of the topographical sheet showing the proposed project road is presented in Figure 2.1 below.

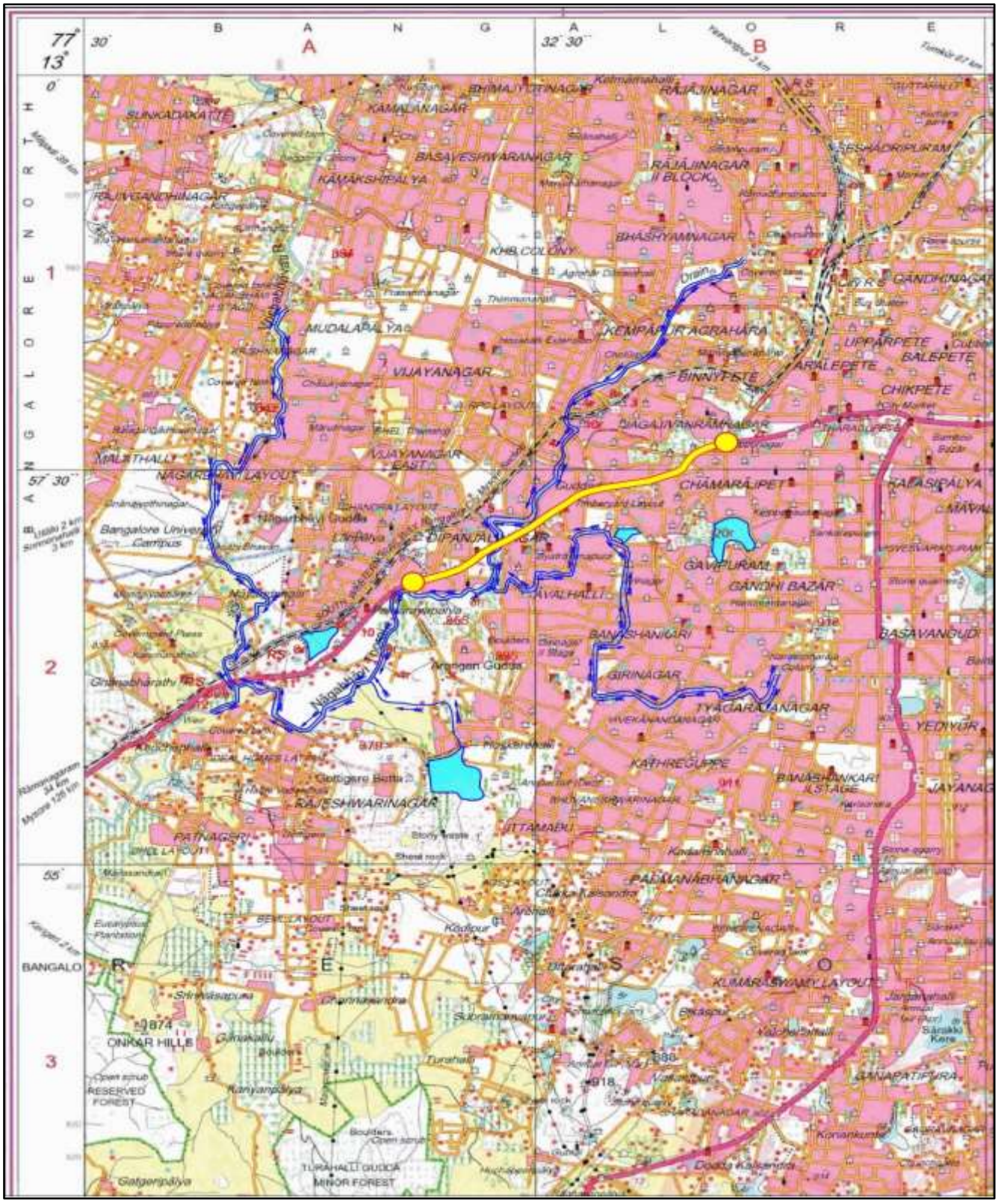


Figure 2-1 survey of India new topo sheet No. D43X9 and Old No. 57 H/9 of the Project Road

The survey topo sheet relevant to the project road is collected from the Survey of India office. Proposed Project road is identified and marked in the survey of India new topo sheet No. D43X9 and Old No. 57 H/9. The purpose of marking the proposed alignment on topo sheet is to get an idea of general topo features in and around the project road and to assess the catchment area for planning drainage network along the project road.

2.2.2 GTS Bench marks

The GTS bench marks stands for Great Trigonometrical Survey. These benchmarks are permanently fixed reference points with known elevations, established by the Survey of India, and are used as a standard for surveying and mapping. They serve as crucial reference points for determining elevations and depths in various surveying projects, especially when establishing mean sea level as a datum.

GTS Bench marks of Survey of India for obtaining Mean Sea Level (MSL)was identified in the project corridor and Digital Auto level was used all along the project corridor for establishing Bench Marks marked on the available permanent structure along the project corridor. The accuracy obtained in levelling survey is 12mm √k where k is distance in km. All levels used in this project are based on Survey of India GTS Bench Mark. These Bench Marks are marked in the topographical survey drawing. The location and details of Available GTS Bench Mark on the corridor are shown below.

Sl. No.	GTS BM No.	Description of Bench Mark	MSL	Topo sheet No
1	OBM 24	Engraved on Cemented Surface of Plinth of Metro Railway Pillar No. P-407 on North of Bangalore to Mysore Road about 11.2m South East from South East corner of Mahindra Cars (Anant Cars) show room building and about 30.0m North from Centre of Bangalore to Mysore road and also about 70.0m north from Indian Oil Petrol Bunk which is about 0.35m above the ground level.	833.392	New No. D43X9 And Old No. 57 H/9

Sl. No.	GTS BM No.	Description of Bench Mark	MSL	Topo sheet No
2	BOM 21	Engraved on Cemented Surface of Plinth of North Pillar of Sri Poojyam Balagangadharanataha Swamyjee Flyover starting towards the K.R. Market / Town Hall on Mysore to Bangalore Road about 40.0m North from Ranganatha Veg Hotel which is about 0.75m above the ground level.	888.455	New No. D43X9 And Old No. 57 H/9

Table 2-1 Survey of India GTS Bench Mark details

2.3 Topographical Survey

The basic objective of the topographic survey was to collect the essential ground features of the proposed junction using Total Station to develop a Digital Terrain Model (DTM), to take care of design requirements of grade separated facility, identifying areas of restriction and their remedies. The data collected will result in the final design and is also used for the Computation of earthwork and other quantities required. The Picture showing the survey work carried out at site is shown in the Figure 2-2 below.

GPS Map Camera
Bengaluru, Karnataka, India
333, Ranganatha Colony, Deepanjali Nagar, Bengaluru, Karnataka 560026, India
Lat 12.947237° Long 77.532937°
TOYOTA
TRUST
GPS Map Camera
Bengaluru, Karnataka, India
333, Ranganatha Colony, Deepanjali Nagar, Bengaluru, Karnataka 560026, India
Lat 12.947262° Long 77.532982°

Figure 2-2 Topographical Survey at Project Road

2.3.1 Detailed Topographical Survey Features

Topographical survey was conducted to capture the site features using 1 second accuracy total station instrument, Digital Auto level equipment and DGPS. The following features were collected during topographical survey to prepare the map of the physical features of the area.

Following existing features have been captured during the survey:

- Building lines, type of buildings (shops or houses, number of stories), trees and Right of Way boundary if available at site by presence of boundary stones.
- Road edges, centerline, shoulders/footpaths, median etc.
- Identifying all religious places, its locations, boundary lines and clear dimensions of compound walls and entrances.
- All service lines both above and below ground such as OFC cables, water and sewer pipes, gas pipes, electrical poles and cables, telephone poles and lines etc.
- Location of traffic islands, median, rotaries, dividers etc.
- Location of road side drains, clearly identifying the type (open/close), width of drain, including the beginning and end of drains.
- Positions of transformers, mast, towers etc.
- Apart from the above, the names of intersecting roads and other landmarks are also recorded and incorporated in the drawing.

Topographic survey was carried out using Total Station of 5-sec accuracy for detailed mapping and with higher accuracy total station during the traversing (min 3 sec). As part of the survey, the following activities were carried out.

Bench Marks : The GTS Bench mark of Survey of India temporarily using Bench marks were marked at every 250m interval on available permanent structure along the project Road. The list of the Bench marks of the project corridor is described in this DPR in Page No. 39, 40 & 41.

Cross – Sections: Cross sections along the road have been taken at every 10 m interval in longitudinal direction for a minimum width of 15m or up to the building lines from the centerline of the existing carriageway on either side of the road. Cross section levels were taken at.

• Centerline of existing carriageway and median edges.

• Points between centerline and edge of carriageway.

• Shoulder/Footpath edges/carriageway edges.

• Additional points at locations of change in ground/critical points.

Longitudinal Section: Longitudinal section levels along the centerline were taken at every 25 m interval. Where curves or important features were encountered, this interval was suitably reduced. Cross sections points for the required width was taken corresponding to each point in the longitudinal section.

Map Plotting: The existing features surveyed were directly imported into Computer Aided Software and the details of the same has been plotted and presented for ready reference.

2.3.2 List of Temporary Bench Mark

The temporary Bench Mark as established at site, is listed in the Table 2-2 below with Coordinates and Elevations.

SL. No.	Easting	Northing	Elevation	Code
1	774946.829	1432745.005	836.092	TBM-2
2	774933.984	1432706.433	834.487	TBM-3
3	775120.827	1432833.687	840.974	TBM-4
4	775144.803	1432849.948	840.713	TBM-5
5	775328.778	1432999.927	835.929	TBM-6
6	775288.772	1433006.381	836.962	TBM-7
7	775430.087	1433064.474	836.425	TBM-8
8	775563.520	1433144.569	840.614	TBM-9
9	775736.653	1433269.370	839.143	TBM-10
10	775730.657	1433321.872	839.290	TBM-11
11	775905.008	1433412.104	844.000	TBM-12
12	776205.233	1433600.876	856.297	TBM-13
13	775419.158	1433339.035	835.995	TBM-13
14	775447.407	1433342.556	836.436	TBM-14
15	776445.010	1433692.461	865.796	TBM-15
16	776581.202	1433718.771	868.623	TBM-16
17	776720.669	1433747.174	871.976	TBM-17
18	776865.446	1433788.689	872.705	TBM-18
19	776989.889	1433826.315	874.114	TBM-19
20	777196.375	1433909.064	881.216	TBM-20
21	777297.252	1434033.964	881.728	TBM-21
22	777429.341	1434132.298	887.208	TBM-22
23	777645.541	1434223.455	890.554	TBM-24
24	777671.989	1434262.331	891.682	TBM-25
25	774819.954	1432665.255	828.786	M/1
26	774867.751	1432684.893	831.041	M/2

SL. No.	Easting	Northing	Elevation	Code
27	774946.866	1432712.370	834.781	M/3
28	775025.347	1432759.955	837.290	M/4
29	775070.315	1432788.500	838.726	M/5
30	775151.964	1432840.975	839.868	M/6
31	775204.456	1432886.253	837.351	M/7
32	775290.304	1432974.167	835.902	M/8
33	775327.612	1433004.724	835.836	M/9
34	775432.224	1433065.913	836.081	M/10
35	775493.061	1433087.741	837.024	M/11
36	775538.477	1433128.997	839.190	M/12
37	775564.599	1433145.482	840.280	M/13
38	775607.418	1433180.936	840.052	M/14
39	775730.302	1433262.689	838.050	M/15
40	775746.294	1433287.525	838.661	M/16
41	775729.296	1433323.013	838.639	M/17
42	775615.974	1433308.756	840.926	M/18
43	775759.699	1433334.067	838.166	M/19
44	775654.828	1433335.593	837.051	M/20
45	775793.821	1433368.947	839.146	M/21
46	775879.262	1433407.922	842.426	M/22
47	775903.727	1433412.300	843.657	M/23
48	775957.905	1433436.730	847.400	M/24
49	776008.173	1433476.664	849.886	M/25
50	776030.444	1433501.117	851.015	M/26
51	776119.852	1433581.611	854.130	M/27
52	776217.439	1433607.692	856.365	M/28
53	776252.016	1433632.473	858.795	M/29
54	776273.498	1433644.670	859.917	M/30
55	776326.589	1433669.501	862.195	M/31
56	776445.533	1433695.118	865.736	M/32
57	776583.751	1433720.890	868.710	M/33
58	776718.702	1433747.439	871.746	M/34
59	776878.706	1433792.848	872.251	M/35
60	776980.172	1433825.658	873.758	M/36
61	777061.403	1433854.503	880.397	M/37
62	777052.396	1433880.169	880.411	M/38
63	777211.686	1433922.313	880.677	M/39
64	777272.188	1434053.786	881.753	M/40
65	777304.244	1434046.561	881.952	M/41
66	777332.915	1434073.495	882.603	M/42
67	777418.730	1434124.109	886.230	M/43

SL. No.	Easting	Northing	Elevation	Code
68	777476.317	1434166.512	888.040	M/44
69	777494.728	1434187.431	888.151	M/45
70	777568.352	1434205.526	888.599	M/46
71	777634.094	1434236.778	890.099	M/47
72	777645.123	1434224.882	890.408	M/48
73	777674.893	1434261.586	891.309	M/49
74	777525.691	1434228.039	888.688	M/50

Table 2-2 List of Temporary Bench Mark with Coordinates

2.4 Traffic Survey

Primary traffic surveys which involve classified volume counts at selected sections along the project corridor to carrying out classified vehicle counts, with appropriate vehicle classification was adopted as per relevant guidelines of IRC keeping in mind the presence of different vehicle categories operating on the project road. The equivalent Passenger Car Unit (PCU) values was used as per relevant IRC guidelines.

The traffic volume count surveys were conducted as per IRC: 106-1990 guild lines, for Fourteen hours from morning 6 am to evening 8 pm to obtain classified count at the Project road. The data was collected on working day by deploying enumerators to record data for each hour within fifteen minutes intervals to obtain data on the magnitude of traffic flow, hourly variation and the traffic composition. Analysis of survey data are discussed in the chapter 5 Design Report.

2.5 Geo Technical Investigations

Introduction

Geotechnical investigation for the proposed project from Sirsi Circle to Nayandahalli on Mysore Road. The total length of the corridor is 4.50 km. The primary objective of this investigation is to establish the geotechnical condition at the site and to evaluate the allowable bearing pressure and other engineering design parameters through the various field and laboratory tests. The report consists of the details on the field and laboratory tests and the recommendations made based on the test results.

Field work comprising of drilling of boreholes conducting SPT tests, collection of samples. The primary objective of this investigation was to obtain information about the sub-surface conditions at the site and obtain net allowable bearing pressure for design of foundations. The location of boreholes for the proposed construction site are marked in the topographical survey map annexed in this report. The Details are summarized below:

Sl. No.	BH No.	Chainage in m	MSL	Depth of explorations (m)	Water Table, m
1	BH-01	335.00	880.325	22.50	Nil
2	BH-02	1524.00	853.501	24	Nil
3	BH-03	2432.00	835.550	18.50	Nil
4	BH-04	2707.00	838.741	18.50	Nil

2.5.1 Objective of Work

The objective of geotechnical investigation is to evaluate the following:

1. Sub-soil strata at the project site
2. Ground water level
3. Physical and engineering properties of soil strata.
4. Allowable safe bearing capacity of soil to design foundations.
5. Chemical properties of Soil

2.5.2 Scope of Work

The scope of geotechnical investigation is carrying out 04 Numbers of borehole investigations at the specified locations. The scope of geotechnical investigation was limited only to the purpose of evaluating the nature & type of sub-soil strata, foundation design parameters to the proposed location.

2.5.3 Borehole Investigation Locations

The locations of the investigations are shown in Topographical Survey Plan which is enclosed in the report.

2.5.4 Coordinates of Borehole Locations

Sl. No.	BH No	Easting (m)	Northing (m)	MSL RL(m)
1	BH 1	777240.782	1433942.795	880.325
2	BH 2	776132.656	1433545.023	853.501
3	BH 3	775387.054	1433040.757	835.550
4	BH 4	775162.00	1432885.815	838.741

2.5.5 Description of Substrata

The subsoil at Bore Hole is seen to consist of silty sand up to 6m to 7.5m depth below the existing ground level followed by silty / sandy clay up to 12m to 13.5m depth. Below 12m and 13.5m depths soil is clayey sand and thereafter soft disintegrated weathered rock extending to16.5m and 18.5m depths respectively is met with finally underlain by hard rock. Water table was not encountered during the period of investigation.

2.5.6 Borehole Investigations

1. For geotechnical investigation work, standard skid mounted rotary type drilling rig was used. Rig is coupled with diesel engine and has tripod and all drilling accessories. Rig deployed is suitable for and has arrangement for driving as well as extracting casing, boring drilling by mud circulation method, conducting Standard Penetration Test (SPT), collection of Undisturbed Soil Sample (UDS) and Disturbed or wash Soil Sample (DS).
2. Drilling bore holes of size 150 mm/Nx size using rotary boring rig up to refusal, collecting necessary disturbed and undisturbed soil samples wherever strata changes.
3. Standard Penetration Test was conducted in the boreholes at regular intervals of 1.5 m or at every change of strata, whichever is earlier as per IS: 2131-1981.
4. Various samples were collected at different depths / wherever strata changes as per IS: 1892 -1979.
5. The samples recovered were sealed in polythene bags, labelled and sent to the laboratory and undisturbed soil sample could not be retrieved as hard strata / rocky strata encountered at shallow depths.

2.5.7 Standard Penetration Test:

Standard Penetration Test (SPT) was conducted as per IS: 2131 – 1981. SPT split spoon sampler of standard dimensions was driven into the soil from the borehole bottom using 63.5 kg hammer falling from 75 cm height. The SPT weight was mechanically lifted to the specified height and allowed to fall freely on the anvil with the use of cat-head winch with one to one and half turn of the drum. Blow counts for the penetration of every 15 cm were recorded and the N is reported as the blow counts for 30 cm penetration of the sampler leaving the first 15 cm penetration as seating drive.

When the number of blows exceeded 50 to penetrate the first or second 15 cm length of the sampler, the SPT N is regarded as more than 100 as described in IS : 2131 - 1981. The test is terminated in such case and a record of penetration of the sampler under 50 blows or more is made. SPT refusal is recorded when there is no penetration of the sampler at any stage and also when a rebound of the sounding system is recorded. The N values are appended in bore log sheet.

N values from Standard Penetration Test (SPT) are shown in the bore log. It is seen that N values are varies from as low as 2 to a maximum of 20 in the overburden soil and is more than 100 in the soft disintegrated weathered rock stratum.

2.5.8 Laboratory Testing

The following laboratory tests are carried out on soil / rock samples collected at site as applicable.

- Bulk density and Moisture Content.
- Grain Size Analysis.
- Water Content, Bulk unit weight and voids ratio
- Triaxial Shear Strength.
- Consolidation properties.
- Atterberg limits

The test results of borehole soil samples are appended in soil properties.

2.5.9 Standing Ground Water Level

During the period of field investigation, standing water / ground water table was not encountered from the existing ground level. A Point to be noted is the ground water table levels are subject to seasonal fluctuations.

2.5.10 Soil Properties

The soil properties obtained from laboratory tests on samples collected at various depths from the borehole. As may be seen, liquid limit values are 52.8% and 50.4% and the corresponding plastic limit values are 26.2% and 27.1%.

2.5.11 Soil Properties

The soil properties obtained from laboratory tests on samples collected at various depths from the borehole. As may be seen, liquid limit values are 52.8% and 50.4% and the corresponding plastic limit values are 26.2% and 27.1%.

2.5.12 Chemical Analysis of Soil Samples

Chemical analysis of soil samples were conducted to determine pH, chlorides and sulphates as per relevant IS Standards. These results are reported in Table below.

BH No.	Sample depth below EGL	pH	Chlorides (Cl), mg/Kg	Sulphates (SO4), mg/Kg
BH 1	7m	7.74	127	29
BH 2	8m	7.54	131	9
BH 3	4m	7.53	116	19
BH 4	4m	7.51	106	22

2.5.13 Bearing Capacity

Chemical analysis of soil samples were conducted to determine pH, chlorides and sulphates as per relevant IS Standards. These results are reported in Table below.

2.5.14 Abutments and Piers

Considering the nature of subsoil, RCC bored cast-in-situ piles of 1m / 1.2m diameter may be adopted. The total pile depth for 1m diameter pile may be taken as 19.5m and 21.5m below existing ground level with an effective socket length of 3m (3 times pile diameter) in the weathered rock stratum. Similarly, the total pile depth below existing ground level for 1.2m diameter pile may be taken as 20.1m and 22.1m with an effective socket length of 3.6m in the weathered rock stratum. The safe vertical axial load on a single vertical pile of 1m diameter works out to 350 tons while for a 1.2m diameter pile the corresponding safe load works out to 500 tons.

2.5.15 Safe Bearing Capacity for open foundation at approach locations

Since the subsoil up to considerable depths has poor bearing capacity, the minimum depth may be taken as 4m below existing ground level and the safe bearing capacity works out to 5 tons/m^2.

2.5.16 Recommendations

1. Subsoil consists of silty sand followed by sandy / silty clay and clayey sand strata and thereafter by soft disintegrated weathered rock finally underlain by weathered rock.

2. RCC Bored cast-in-situ piles of 1m / 1.2m diameter may be adopted. Pile depth shall be such that it is socketted in weathered rock for a minimum length of 3 times pile diameter. The theoretical safe vertical axial load on a single vertical pile works out to 350 tons and 500 tons respectively for 1m and 1.2m diameter piles. The safe load values shall be confirmed from load tests as per codal requirements.

3. Open foundations placed at minimum 4m depth below existing ground level may be adopted for the approaches and the safe bearing capacity may be taken as 5 tons/m^2.

Conclusion

The scope of the geotechnical investigation was limited to evaluating the nature and type of sub-soil strata, determining foundation design parameters, and identifying the type and depth of sub-structure foundations at the project site. The recommendations provided are based on the limited field and laboratory tests carried out during this stage.

During actual excavation for construction, further recommendations and appropriate modifications may be required. Any discrepancies observed between site conditions and this report should be immediately brought to the notice of the project consultant, who will provide suitable guidance.

It must be emphasized that this report is intended solely for the preparation of the Detailed Project Report (DPR) and tender processing purposes. A comprehensive soil investigation shall be undertaken by the contractor at the execution stage, in accordance with the final design requirements

BORE HOLE LOG SHEETS

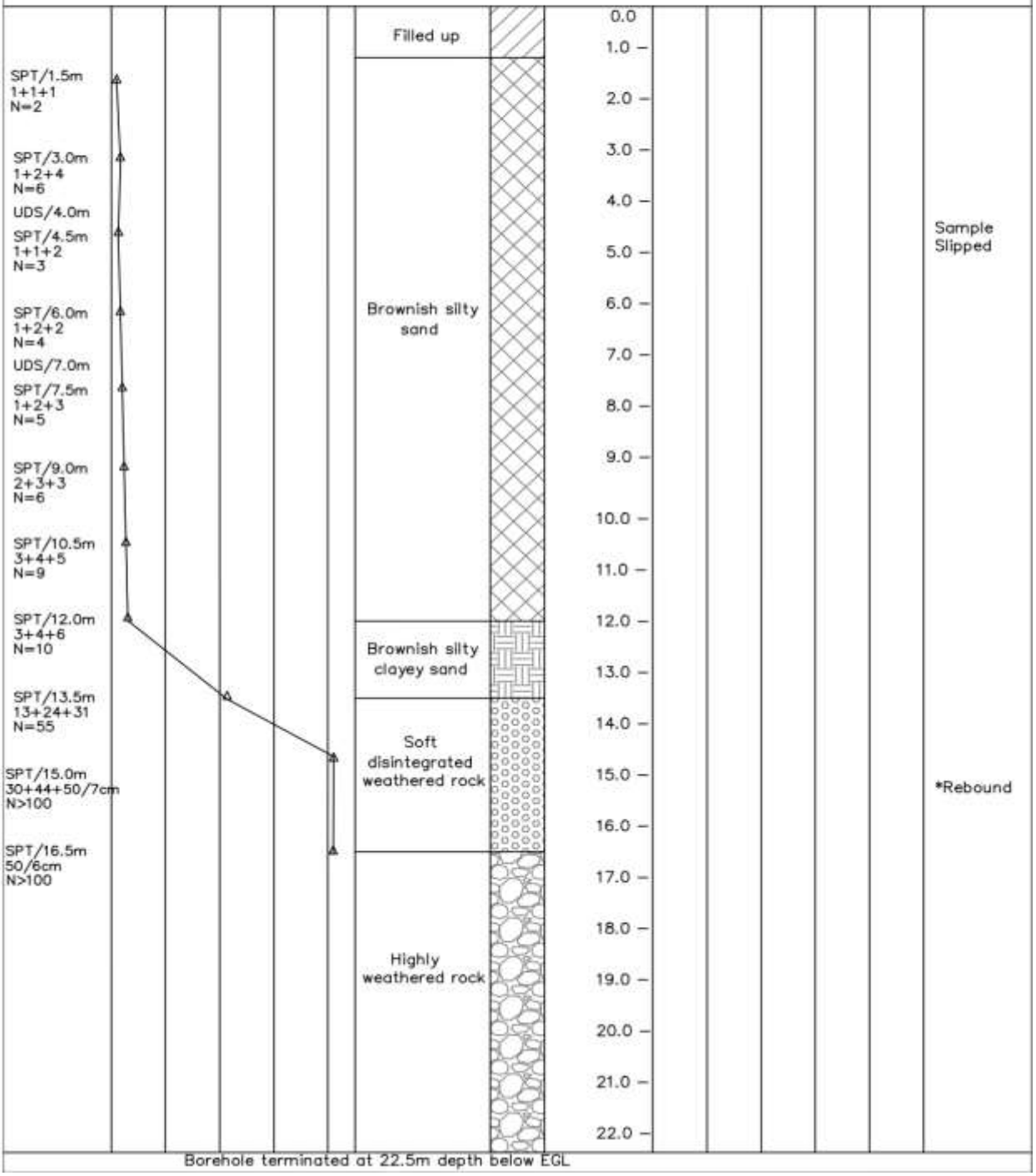
BOREHOLE LOG

Project : Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road

Cilent : Bengaluru Smart Infrastructure Limited (B Smile), # 108, 1st Floor, Annexe-2 Building, N.R.Square, Bengaluru-560002.

BH No : 01 **Termination Depth : 22.5m**

Location : Marked in Topographigal Survey Drawing **Page No : 01**



BOREHOLE LOG

Project : Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road

Cilent : Bengaluru Smart Infrastructure Limited (B Smile), # 108, 1st Floor, Annexe-2 Building, N.R.Square, Bengaluru-560002.

BH No : 02 **Termination Depth : 24.0m**

Location : Marked in Topographigal Survey Drawing **Page No : 01**

Sample/ Type SPT	N Value 25	50	75	100	Description of Strata	Depth Below Ground Level (m)	Cores Run No.	Depth(m)	No. of Pieces	Recovery%	RQD	Remarks
SPT/1.5m 2+2+3 N=5					Filled up	0.0 – 1.0						
SPT/3.0m 2+2+2 N=4					Brownish silty sand	1.0 – 2.0 – 3.0 – 4.0						
UDS/4.0m												
SPT/4.5m 5+8+9 N=17						4.0 – 5.0						Sample Slipped
SPT/6.0m 7+9+10 N=19						5.0 – 6.0 – 7.0						
SPT/7.5m 2+5+9 N=14						7.0 – 8.0						
UDS/8.0m												
SPT/9.0m 3+3+8 N=11						8.0 – 9.0						
SPT/10.5m 5+7+8 N=15					Brownish sandy clayey sand	9.0 – 10.0 – 11.0						
SPT/12.0m 6+9+11 N=20						11.0 – 12.0 – 13.0						
SPT/13.5m 6+11+11 N=22					Brown yellow clayey sand	13.0 – 14.0 – 15.0						
SPT/15.0m 14+20+23 N=43												*Rebound
SPT/16.5m 20+24+27 N=51					Soft disintegrated weathered rock	15.0 – 16.0 – 17.0 – 18.0						
SPT/18.0m 28+35+39 N=74												
					Highly weathered rock	18.0 – 19.0 – 20.0 – 21.0 – 22.0 – 23.0 – 24.0						

Borehole terminated at 24.0m depth below EGL

BOREHOLE LOG

Project : Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road

Cilent : Bengaluru Smart Infrastructure Limited (B Smile), # 108, 1st Floor, Annexe-2 Building, N.R.Square, Bengaluru-560002.

BH No : 03 **Termination Depth : 18.5m**

Location : Marked in Topographigal Survey Drawing **Page No : 01**

Sample/ Type SPT	N Value 25	50	75	100	Description of Strata	Depth Below Ground Level (m)	Cores Run No.	Depth(m)	No. of Pieces	Recovery%	RQD	Remarks
SPT/1.5m 3+5+6 N=11					Filled up	0.0 – 1.0						
SPT/3.0m 6+8+8 N=16					Brownish silty sand	1.0 – 3.0						Sample Slipped
UDS/4.0m												
SPT/4.5m 4+6+6 N=12					Brownish Clay	3.0 – 6.0						
SPT/6.0m 3+5+7 N=12												
SPT/7.5m 2+3+5 N=8					Brownish silty sandy Clay	6.0 – 10.0						
UDS/8.0m												
SPT/9.0m 3+4+6 N=10												
SPT/10.5m 29+42+50/3cm N>100					Soft disintegrated weathered rock	10.0 – 13.0						
SPT/12.0m 50/7cm N>100												
					Highly weathered rock	13.0 – 18.0						

Borehole terminated at 18.5m depth below EGL

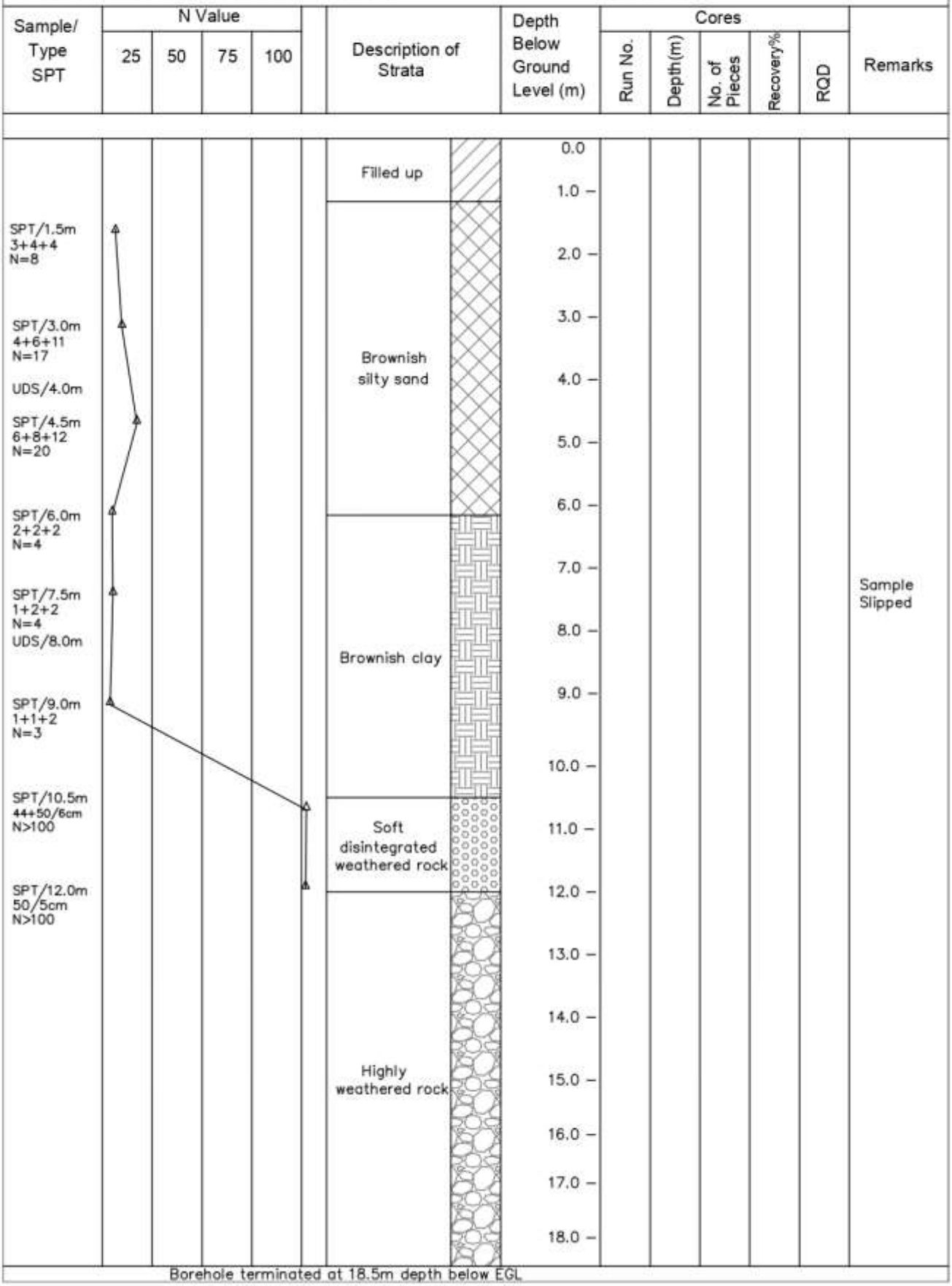
BOREHOLE LOG

Project : Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road

Cilent : Bengaluru Smart Infrastructure Limited (B Smile), # 108, 1st Floor, Annexe-2 Building, N.R.Square, Bengaluru-560002.

BH No : 04 **Termination Depth : 18.5m**

Location : Marked in Topographigal Survey Drawing **Page No : 01**



2.6 Project Road Inventory

An Existing Road Condition Survey was carried out for the project corridor. During the survey, the following parameters were recorded:

Carriageway – Existing width and pavement type **Footpat**h – Width and type along both sides

Drainage – Width and type of RCC drains **Right of Way (ROW**) – Existing ROW width

Vegetation – Trees falling within the proposed alignment that require cutting or trimming

All details were systematically documented and are presented in the table below for clarity and reference.

Tree Details				
Sl. No.	**Cutting of Trees**	**Nos**	**Cutting the branches of Tree**	**Nos**
1	Tree Transplantation	09	Cutting of branches of trees and shrubs from the road way or with in R.O.W including disposal of wood and leaves to suitable location as per technical specification	**45**
2	Girth from 600mm to 900mm	13		
3	Girth from 900 mm to 1800mm	17		
4	Girth above 1800mm	06		
	Total	**45**		**45**

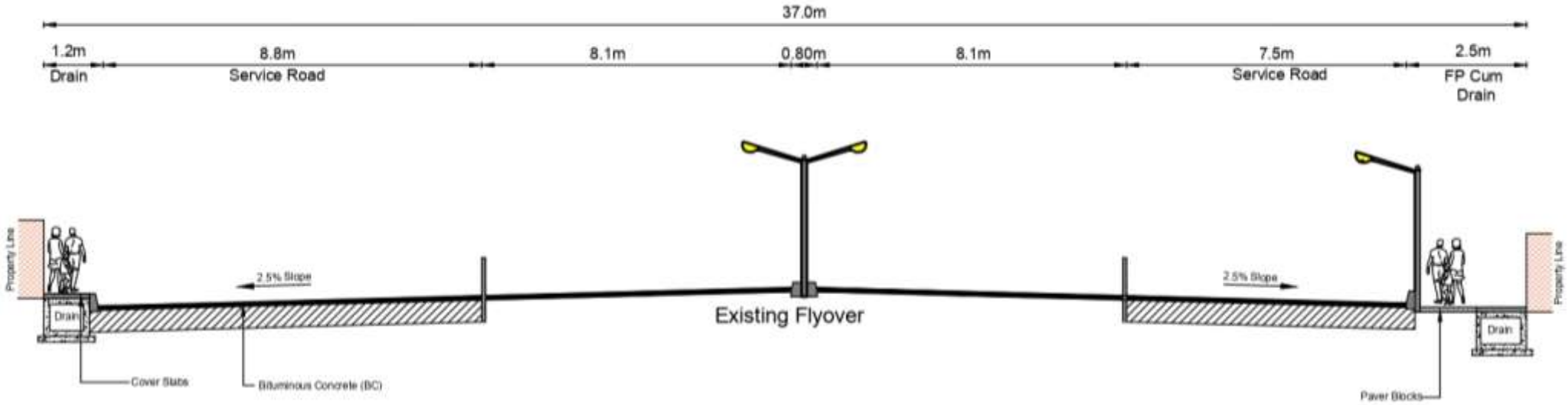
Road Inventory Survey Details

Sl. No.	**Chainage (m)**	**Width of Carriageway in (m)**			**Total Width of Carriage way in (m)**	**Type of Drain**		**Width of Drain in (m)**		**Width of Footpath in (m)**		**Total EROW Width in (m)**
		LHS	**Median**	**RHS**		**LHS**	**RHS**	**LHS**	**RHS**	**LHS**	**RHS**	
1	0+000	8.40	2.80	10.70	21.90	-	-	-	-	2.60	-	24.5
2	0+050	12.60	4.80	13.20	30.60	-	-	1.00	-	0.90	2.70	35.2
3	0+100	31.45			31.45	-	-	1.00	-	1.10	2.35	35.9
4	0+150	29.90			29.90	-	-	1.00	-	-	2.30	33.2
5	0+200	15.7	0.8	17.3	33.80	-	-	-	-	2.4	2.2	38.4
6	0+250	18.9	1.0	15.7	35.60	-	-	-	-	3.2	2.7	41.5
7	0+300	14.7	1.0	15.9	31.60	-	-	-	-	2.9	2.3	36.8
8	0+350	15.6	1.0	11.9	28.50	-	-	-	-	4.5	2.7	35.7
9	0+400	-	-	28.6	28.60	-	-	-	-	4.1	3.6	36.3
10	0+450	13.8	1.1	10.1	25.00	-	-	-	-	3.5	2.1	30.6
11	0+500	10.8	0.9	10.2	21.90	-	-	-	-	2.4	2.9	27.2

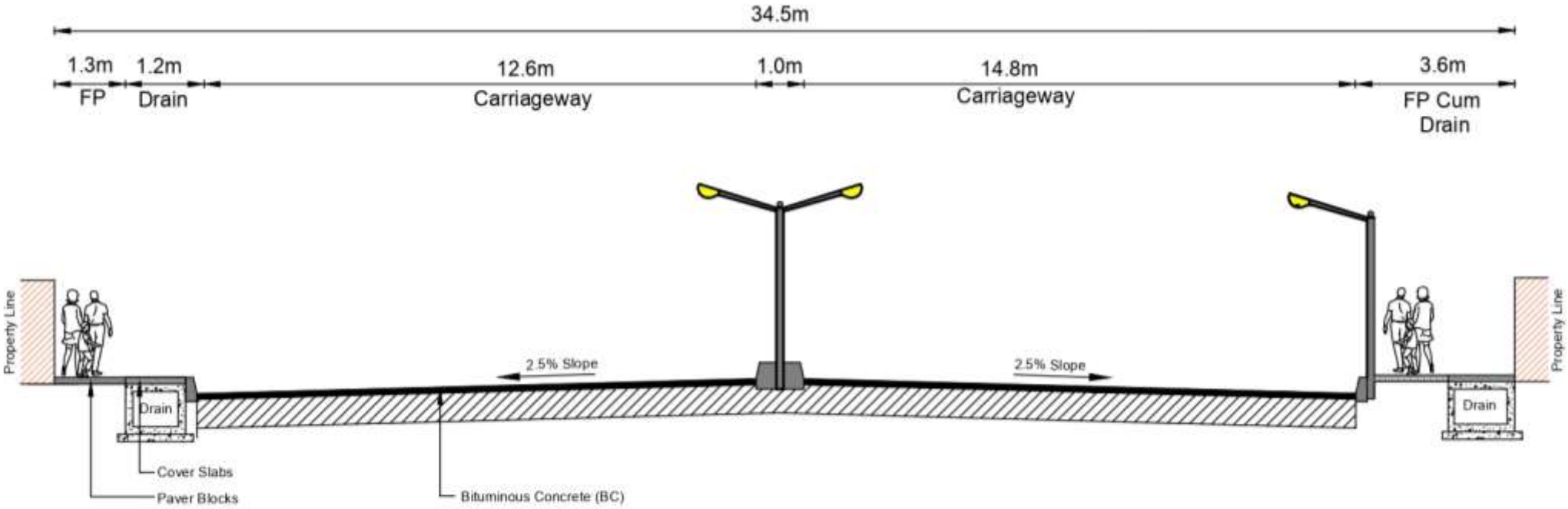
Sl. No.	Chainage (m)	Width of Carriageway in (m)			Total Width of Carriage way in (m)	Type of Drain		Width of Drain in (m)		Width of Footpath in (m)		Total EROW Width in (m)
		LHS	Median	RHS		LHS	RHS	LHS	RHS	LHS	RHS	
12	0+550	10.7	1.2	11.0	22.90	-	-	-	-	2.1	2.1	27.1
13	0+600	11.1	1.0	11.6	23.70	-	-	-	-	2.6	1.9	28.2
14	0+650	12.0	1.1	12.6	25.70	-	-	-	-	4.2	2.0	31.9
15	0+700	11.4	1.0	23.2	35.60	-	-	-	-	4.3	2.3	42.2
16	0+750	11.0	1.1	12.1	24.20	-	-	-	-	4.3	2.1	30.6
17	0+800	10.7	1.1	11.8	23.60	-	-	-	-	2.8	2.1	28.5
18	0+850	10.7	1.1	11.6	23.40	-	-	-	-	1.1	2.1	26.6
19	0+900	-	-	23.2	23.20	-	-	-	-	3.3	1.7	28.2
20	0+950	10.3	0.7	10.8	21.80	-	-	-	-	3.0	1.7	26.5
21	1+000	11.4	0.6	9.9	21.90	-	-	-	-	3.1	1.1	26.1
22	1+050	11.8	0.6	10.4	22.80	-	-	-	-	2.0	1.2	26.0
23	1+100	11.1	0.6	10.3	22.00	-	-	-	-	4.0	0.7	26.7
24	1+150	11.1	0.6	10.7	22.40	-	-	-	-	4.3	3.7	30.4
25	1+200	10.9	0.8	11.1	22.80	-	-	-	-	3.3	3.9	30.0
26	1+250	10.7	0.7	10.6	22.00	-	-	-	-	3.4	4.5	29.9
27	1+300	10.6	0.7	12.4	23.70	-	-	-	-	3.3	2.1	29.1
28	1+350	10.8	0.6	11.8	23.20	-	-	-	-	3.0	3.4	29.6
29	1+400	13.7	0.9	11.6	26.20	-	-	-	-	4.8	3.5	34.5
30	1+450	13.8	0.6	11.2	25.60	-	-	-	-	7.0	3.7	36.3
31	1+500	14.6	0.6	10.5	25.70	-	-	-	-	3.3	3.8	32.8
32	1+550	9.9	0.5	9.9	20.30	-	-	-	-	2.3	4.2	26.8
33	1+600	12.9	0.7	15.3	28.90	-	-	-	-	2.1	2.1	33.1
34	1+650	16.0	0.7	15.9	32.60	-	-	-	-	2.2	2.5	37.3
35	1+700	13.7	0.7	14.8	29.20	-	-	-	-	2.1	3.1	34.4
36	1+750	13.8	0.8	15.2	29.80	-	-	-	-	2.2	3.2	35.2
37	1+800	14.2	0.7	15.3	30.20	-	-	-	-	2.5	4.2	36.9
38	1+850	-	-	24.5	24.50	-	-	-	-	3.2	5.6	33.3
39	1+900	11.0	0.7	11.5	23.20	-	-	-	-	3.1	-	26.3
40	1+950	11.3	0.8	12.1	24.20	-	-	-	-	4.2	3.9	32.3
41	2+000	12.0	0.8	16.5	29.30	-	-	-	-	2.6	-	31.9
42	2+050	12.7	0.7	13.1	26.50	-	-	-	-	1.9	2.1	30.5

Sl. No.	Chainage (m)	Width of Carriageway in (m)			Total Width of Carriage way in (m)	Type of Drain		Width of Drain in (m)		Width of Footpath in (m)		Total EROW Width in (m)
		LHS	Median	RHS		LHS	RHS	LHS	RHS	LHS	RHS	
43	2+100	13.6	0.7	10.9	25.20	-	-	-	-	2.1	2.1	29.4
44	2+150	14.6	0.7	13.6	28.90	-	-	-	-	1.4	2.1	32.4
45	2+200	11.4	0.8	16.6	28.80	-	-	-	-	-	-	28.8
46	2+250	-	-	15.4	15.40	-	-	-	-	-	1.8	17.2
47	2+300	-	-	14.1	14.10	-	-	-	-	2.0	2.0	18.1
48	2+350	-	1.8	15.2	17.00	-	-	-	-	-	2.0	19.0
49	2+400	-	-	14.1	14.10	-	-	-	-	3.5	2.1	19.7
50	2+450	-	2.9	9.3	12.20	-	-	-	-	3.0	-	15.2
51	2+500	-	-	29.9	29.90	-	-	-	-	2.8	-	32.7
52	2+550	-	-	19.8	19.80	-	-	-	-	1.4	3.4	24.6
53	2+600	-	-	23.4	23.40	-	-	-	-	-	-	23.4
54	2+650	-	-	26.5	26.50	-	-	-	-	4.6	-	31.1
55	2+700	55.5			55.50	-	-	-	-	7.4	-	62.9
56	2+750	10.8	3.6	7.7	22.10	-	-	-	-	6.7	1.1	29.9
57	2+800	15.7	2.9	7.9	26.50	-	-	-	-	4.6	1.1	32.2
58	2+850	20.6	3.0	10.0	33.60	-	-	-	-	3.6	1.1	38.3
59	2+900	12.2	2.9	10.4	25.50	-	-	-	-	1.5	0.9	27.9
60	2+950	10.8	2.5	10.9	24.20	-	-	-	-	1.5	0.9	26.6
61	3+000	11.6	2.6	10.5	24.70	-	-	-	-	1.3	2.2	28.2
62	3+050	12.0	2.5	10.0	24.50	-	-	-	-	1.6	4.3	30.4
63	3+100	12.8	2.7	10.6	26.10	-	-	-	-	1.3	4.6	32.0
64	3+150	11.4	1.9	12.9	26.20	-	-	-	-	-	3.2	29.4
65	3+200	13.3	1.4	11.7	26.40	-	-	-	-	4.1	1.8	32.3
66	3+250	14.9	1.4	11.5	27.80	-	-	-	-	-	1.8	29.6
67	3+300	15.9	1.0	16.5	33.40	-	-	-	-	1.5	1.7	36.6
68	3+350	17.7	0.9	18.8	37.40	-	-	-	-	1.6	2.4	41.4

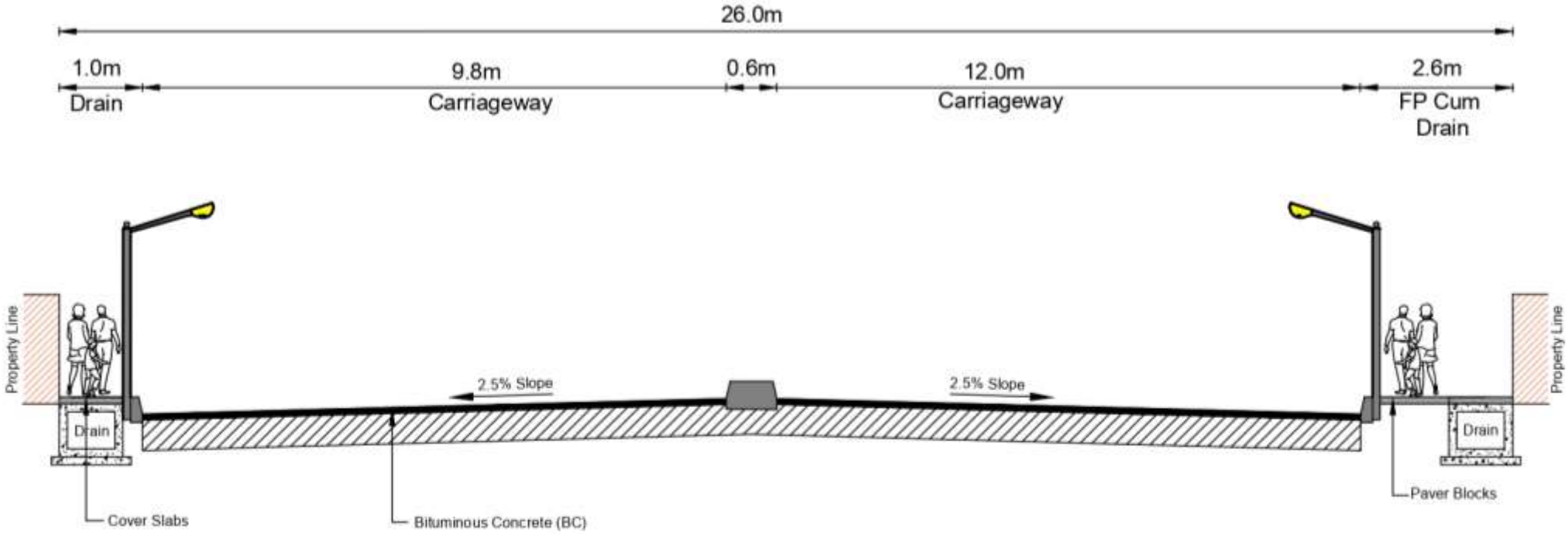
2.7 Existing Cross Section of the project road with chainage



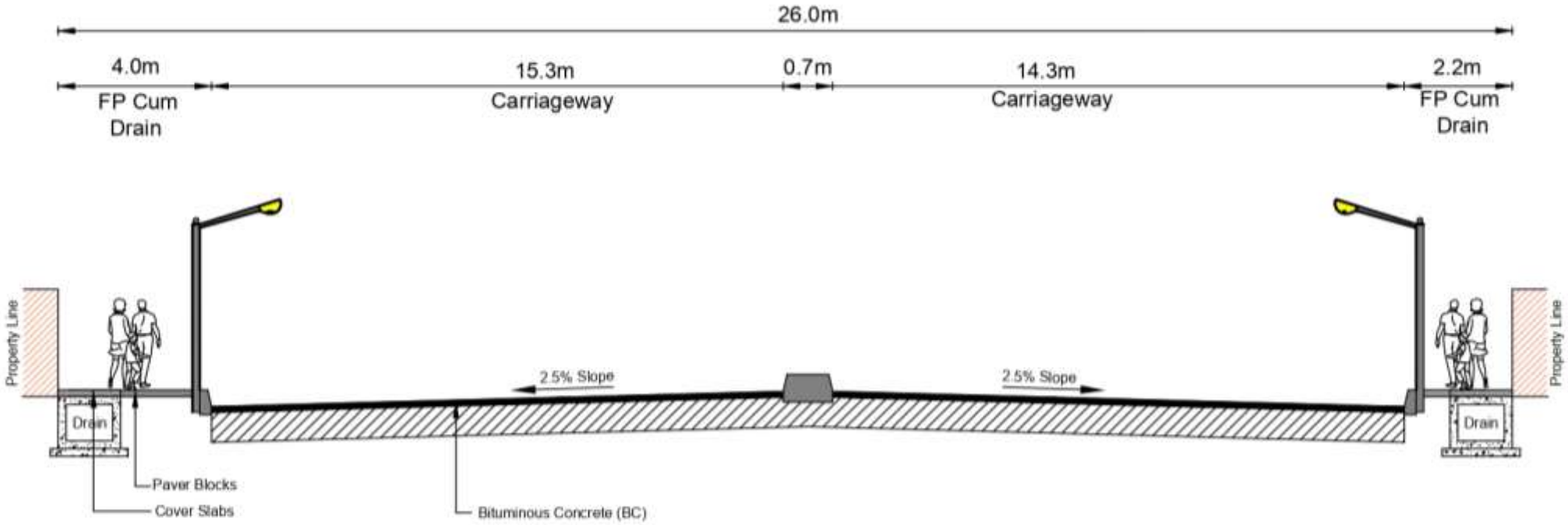
Existing Cross Section @ Chainage 0+150



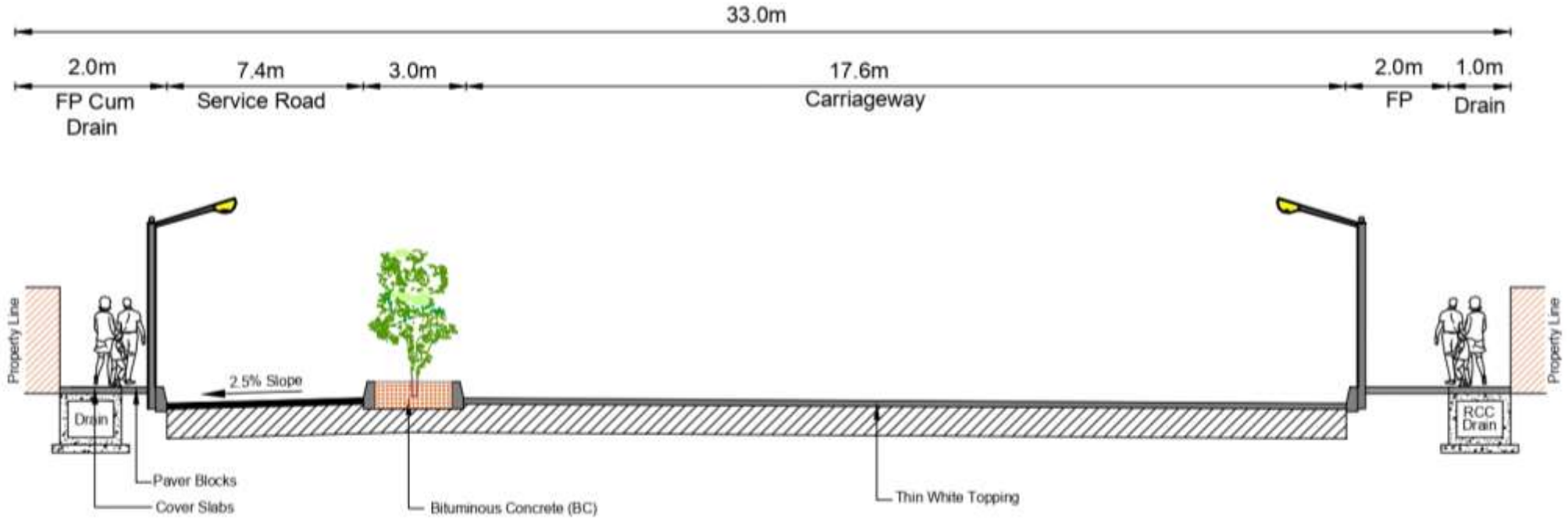
Existing Cross Section @ CH: 0+330



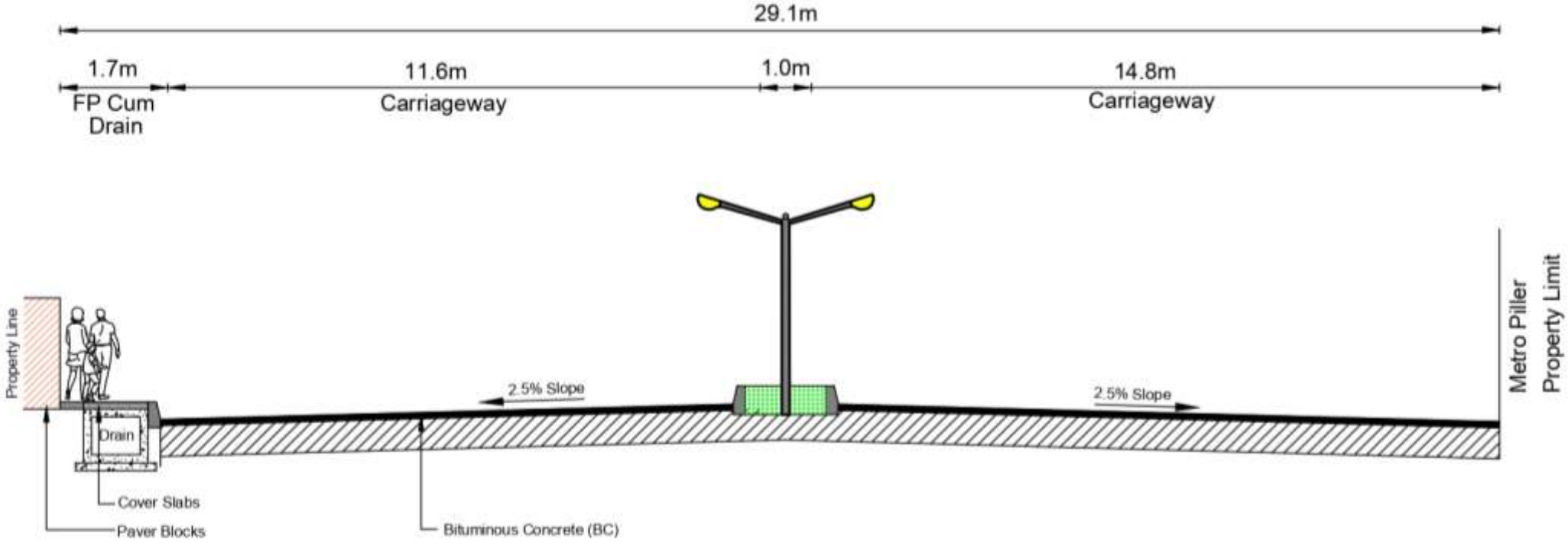
Existing Cross Section @ CH: 1+025



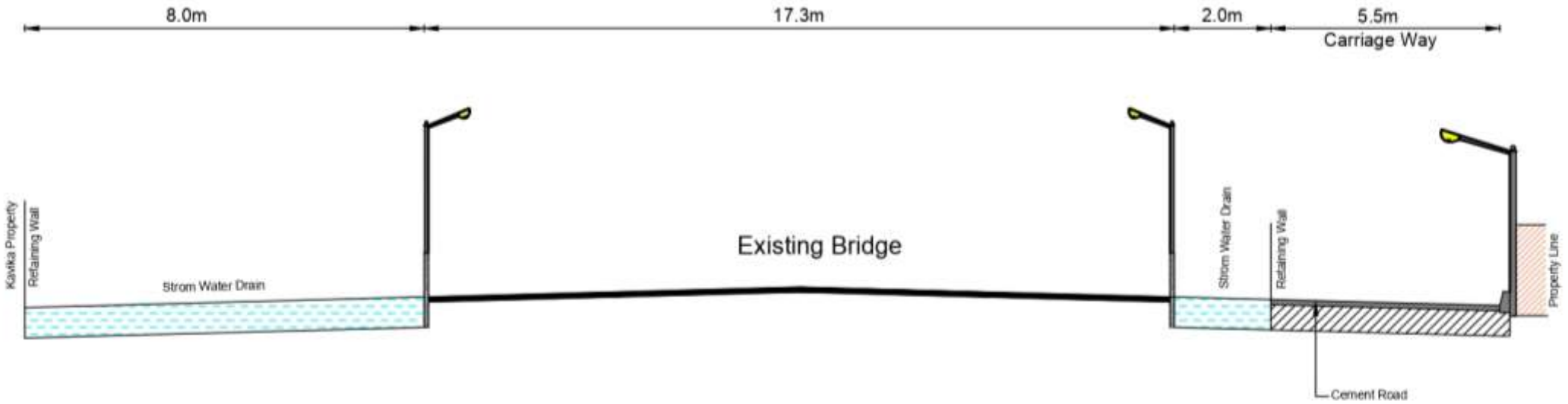
Existing Cross Section @ CH: 1+800



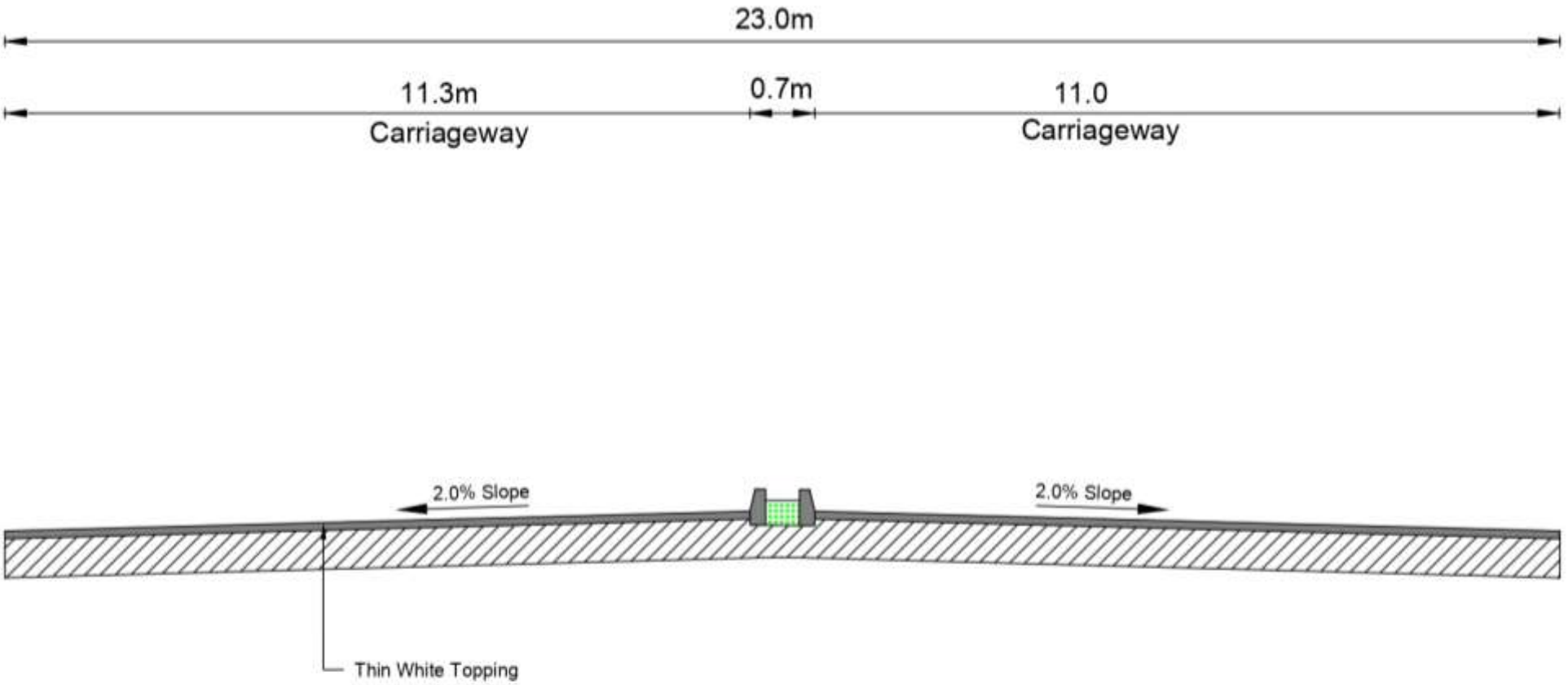
Existing Cross Section @ CH: 2+450



Existing Cross Section @ CH: 3+250



Cross Section @ Chainage 0+125



Existing Cross Section @ Chainage 0+250 (NICE Road)

2.8 Project Road Images

The reconnaissance survey was conducted prior to the detailed design stage. During this survey, the existing site conditions were documented and captured through photographs, which are annexed below for reference.

Sirsi Circle	Sirsi Circle
Sirsi Circle	Sirsi Circle

Sri Gali Anjaneya Swami Temple

Bengaluru, Karnataka, India
208, Mysore Rd, Byatarayanapura, Banashankari 1st Stage, Banashankari, Bengaluru, Karnataka 560050, India
Lat 12.952844° Long 77.541515°

Bengaluru, Karnataka, India
2, Mysore Rd, Opp. Gaali Anjaneya Swamy Temple, Deepanjali Nagar, Banashankari 1st Stage, Azad Nagar, Bengaluru, Karnataka 560026, India
Lat 12.952404° Long 77.541255°

Bengaluru, Karnataka, India
Bus Stand, 20, Mysore Rd, Near Satellite Bus Stand, Byatarayanapura, Banashankari 1st Stage, Satellite, Bengaluru, Karnataka 560026, India
Lat 12.952972° Long 77.54176°

Bengaluru, Karnataka, India
304, Mysore Rd, Byatarayanapura, Banashankari 1st Stage, Nayanda Halli, Bengaluru, Karnataka 560026, India
Lat 12.860551° Long 77.537932°
17/08/2025 11:10 AM GMT +05:30
Google

GPS Map Camera
Bengaluru, Karnataka, India
333, Ranganatha Colony, Deepanjali Nagar,
Bengaluru, Karnataka 560026, India
Lat 12.947243° Long 77.532972°
11/07/2026 08:27 AM GMT +05:30
Google

Bharat Heavy Electricals Limited

3 Methodology and Design Standards

3.1 General

After the study of the Traffic survey details and Interference at the project road, an arrangement best suiting to the traffic pattern is proposed for improving the traffic situation. Proposal is evolved giving due consideration to minimize land acquisition. All the site constraints have been taken care while formulating the improvement scheme.

Efforts have been made to create a conflict-free situation within the possible limits of the right of way, the main objective of which is to greatly improve the current situation and expand the flow of traffic as much as possible.

Current and future traffic growth pattern, location of bus stops, intersection, environmental impact etc. are considered. Thereafter, a traffic survey to estimate the future population of traffic is conducted in order to determine the number of lanes in each direction. The planned layout of the flyover is carefully chosen to avoid disturbance to traffic and maximize the decongestion potential.

3.2 Study of Existing Project Road

The Project road has been studied and the starting point of the project road is Sirsi Circle and ending point of the project is start of existing Nayandahalli Flyover. A traffic circulation plan with signaling details from the project road is prepared for better understanding of the project road which is enclosed above in this report.

After analyzing the traffic and road inventory survey of the project road, the improvement proposal was considered and a detailed study was carried out to suggest a suitable concept of proposal for the elevated road.

3.3 Augmentation of Traffic capacity

The project road is located close to the Central Business District (CBD) and is surrounded by established localities such as K.R. Market, Chamarajpet, Satellite Bus Stand, and major religious places including Edgah, Masjid, and Sri Gali Anjaneya Swamy Temple. Being situated in the heart of the city, the corridor also forms part of National Highway 275, which connects Bengaluru with Mysuru and other important regions in the southwest of Bengaluru.

There is a pressing need to augment the capacity of arterial roads in the CBD and Mysuru Road corridor. While at-grade widening is the default option, the limitations of land acquisition along the project road necessitate consideration of capacity augmentation through elevated roads.

With the implementation of the proposed elevated corridor, vehicles coming from Nayandahalli, Deepanjali Nagar, Vijayanagar, and Hosakerehalli via Mysuru Road can reach Town Hall Junction more efficiently. This will significantly reduce congestion and delays.

A flyover connecting Nayandahalli and Sirsi Circle is essential to address the severe traffic congestion currently experienced on Mysuru Road. The existing route suffers from delays, particularly at signalized junctions, which adversely impact commuting time, fuel efficiency, and overall mobility. The proposed elevated corridor will provide a faster, more direct route, thereby reducing travel time and improving traffic flow.

Beyond immediate traffic relief, elevated corridors play a vital role in connecting different parts of the city and the country, serving as critical infrastructure pillars that support urban growth and national development.

3.4 Structural type Options

Depending on span length, space availability, construction speed requirements, traffic management constraints, machinery and material movement limitations, and environmental considerations, one of the following structural types is selected for elevated corridors after evaluating their advantages and disadvantages:

i. Cast-in-situ on staging
ii. Precast at site or in casting yard, then erected or launched
iii. Segmental construction (cast-in-situ or precast)
iv. Incremental launching (push-in method)

For the superstructure, continuous spans are preferred as they reduce structural depth, improve riding quality and durability, and enhance aesthetics. Minimizing substructure depth also helps reduce the overall flyover length.

Segmental construction is often adopted in urban situations to facilitate smooth traffic flow during construction and to accelerate project timelines.

The following superstructure options were studied to meet IRC standards and arrive at the most suitable, economical, and site-specific solution:

a) Elevated road with precast I-girder
b) Elevated road with full-span precast box girder
c) Elevated road with segmental precast box girder
d) Elevated road with UHPFRC U-girder

3.4.1 Elevated Road with Pre-cast I- Girder.

Elevated roads using precast I-girders and box girders offer advantages such as faster construction, reduced on-site labor, and improved quality control. I-girders, with their simple I-shaped form, are economical and lighter for shorter spans. However, they have limited torsional stiffness, require deeper sections as spans increase, and involve cumbersome transport and launching operations. These factors can lead to longer construction timelines and higher substructure costs when applied to extended urban corridors. For this reason, while I-girders remain suitable for limited span applications, modern alternatives such as precast PSC box girders, double-T girders, or UHPFRC girders are generally preferred for elevated roads, as they provide greater efficiency, durability, and speed of construction.

3.4.2 Elevated road with Box Girder with full span precast

Simple box girders are efficient structural forms for spans up to 60 m, whether in simply supported or continuous construction. They also have wide applicability for longer spans, particularly when segmental construction is adopted.

Box Girder: A closed, hollow section with two flanges and two or more webs.

a. Advantages:

i. High torsional resistance due to the enclosed section.
ii. Capable of spanning longer distances than I-girders for the same depth.
iii. Suitable for carrying larger loads and applications where torsional stiffness is critical.

b. Disadvantages:

i. More complex to precast and construct in full-span lengths compared to I-girders.
ii. Heavier for the same load-bearing capacity, leading to higher costs.

For time-bound mass rapid transit projects (metros, high-speed rail), full-span precast box girders are generally preferred over segmental precast box girders. They enable faster construction progress, minimize traffic disruption, and deliver superior quality since the entire girder is cast in one operation at ground level, avoiding segmental joints.

However, transporting and launching full-span precast box girders is significantly more challenging than segmental girders, especially in congested urban environments. Constraints include limited space, traffic management, movement of heavy machinery and materials, and environmental considerations. Specialized equipment such as molds, straddle carriers, bridge gantries, launching girders, and girder transporters is required, increasing capital costs. Despite these costs, the method offers substantial benefits in speed and quality.

In dense urban areas, bidder participation for full-span girder tenders is often limited due to traffic congestion and logistical difficulties. Considering these challenges, the full-span precast box girder

option was not selected for this project. The photo showing launching of full span box girder is shown in Figure 3-1below.

Figure 3-1 Launching of Full span Box girder

3.4.3 Elevated road with Segmental pre-cast Box girder.

Full-span girders are designed to be launched in one piece, enabling faster construction progress, while segmental girders are built in multiple precast sections and are more adaptable to complex geometries.

The project road includes both straight and curved alignments, requiring careful design to ensure safety, comfort, and efficiency. A segmental box girder is particularly suitable for such geometry, as it offers advantages in handling combinations of straight and curved spans. Segmental girders are constructed from multiple precast segments joined together at the project site, whereas full-span girders are cast as a single continuous piece for the entire span.

Urban environments often present challenges for flyover construction, including traffic disruption, space limitations, and the need to work around existing infrastructure. Segmental precast box girders are well suited to overcome these constraints. They are widely adopted for urban flyovers due to their efficiency, speed of construction, and ability to accommodate complex geometries. In addition, they minimize traffic disruption, provide high quality control, and ensure long-term durability, making them an ideal choice for densely populated areas. A launching photo of the segmental pre-cast girder is shown in Figure 3-2 below.

Figure 3-2 Launching of Segmental elements of Box Girder

3.4.3.1 Segmental Box Girder Concept

A segmental box girder flyover is a bridge structure where hollow box-shaped girders are constructed from precast or cast-in-situ concrete segments, connected and post-tensioned to form a continuous superstructure. This method combines the strength and torsional resistance of box girders with the efficiency and adaptability of segmental construction, making it suitable for long spans and complex alignments.

For wide decks exceeding 15 m, single-cell box girders with struts supporting the deck cantilevers, or with internal struts to reduce slab spans, are preferred. These configurations avoid the need for multi-cell box girders, which are more difficult to construct. Such geometry is particularly encouraged in the design of the proposed 17.2 m wide elevated flyover.

As span length increases, girder depth also increases, requiring larger substructures and foundations. This leads to longer construction timelines and higher costs. In urban environments, where traffic growth and space constraints demand rapid solutions without land acquisition, segmental box girders provide efficiency and adaptability.

Recent advances in Ultra-High Performance Fiber-Reinforced Concrete (UHPFRC) technology allow spans of 70–100 m to be precast in thinner sections, reducing self-weight and minimizing substructure requirements. This results in faster construction and cost savings. While UHPFRC technology has been introduced in India and encouraged at the DPR stage, its adoption is still emerging.

Considering the site conditions and constraints of this project, the use of segmental precast box girders is not recommended at this juncture, though UHPFRC remains a promising option for future applications.

Project Site Visit for understanding new technology adopted for Flyover

A site visit to Nagpur, Maharashtra was conducted on 18-07-2025 along with departmental officials to study the new technology adopted in the ongoing flyover project in Nagpur city. The team visited the project site where construction activities were in progress, as well as the casting plant where girders were being manufactured. Observations included the processes of girder transportation to the project location and launching at site.

Detailed discussions were held with officials of the National Highways Authority of India (NHAI), the client for the project, and with the contractor to understand the challenges encountered during construction. Project details and photographs from the site visit are enclosed in this report.

Location	Nagpur, Maharastra
Date of Site Visit	18-07-2025
Name of the Project	Construction of Flyover from Indora Square to Shitalmata Chowk, Nagpur in the state of Maharastra
Client	National Highway Authority of India, G 5&6 Sector 10, Dwaraka, New Delhi-110075
Contractor	Nagarjuna Construction Company Ltd. (NCC), NCC House, Madhapur, Hydrabad-500081, Email: info@nccltd.in
Project Cost	760.76 Cr
Project Duration	24 months
Maintainance Period	10 Years
Length of the Elevated Corridor	8.90 Km
Width of Flyover	12.0m
Status of the project as on date	Under Construction

Photos captured during site visit

STOP
Please Sound Horn
NCC

3.4.3.2 Ultra – High Performance Fiber- Reinforced Concrete U Girder

As Bengaluru Smart Infrastructure Limited (B-SMILE) advances towards building high-speed corridors with shorter implementation timelines, innovation and modernization are essential. Ultra-High Performance Concrete (UHPC) offers an ideal solution to this challenge. With compressive strengths ranging from 150 to 250 MPa, UHPC provides exceptional durability and mechanical performance, enabling the production of structural components that are lightweight and slender in section.

These qualities allow UHPC systems to be adopted more widely in elevated infrastructure, reducing dead load and improving efficiency. Compared to conventional cast-in-situ construction or precast systems using normal high-strength concrete, UHPC enables faster transportation and erection of longer precast elements with lower energy requirements.

The use of UHPC can also result in slimmer bridge piers than those required with conventional concrete, accelerating construction and freeing valuable ground space in metropolitan areas. This is particularly advantageous for elevated road projects, as it increases carriageway space and minimizes disruption to existing traffic

3.4.3.3 Making process of UHPFRC

The performance of Ultra-High Performance Fiber-Reinforced Concrete (UHPFRC) depends on achieving low porosity and optimized particle packing. Reducing porosity increases strength, durability, and resistance to environmental degradation. This is accomplished through:

a. Close packing of raw materials to minimize voids.
b. • Use of superplasticizers (HRWR additives) to reduce water demand while maintaining workability.
c. • Incorporation of finely ground reactive mineral admixtures to enhance density and performance.
d. • Low water-to-binder ratio (w/b), which is critical for achieving high strength and durability.
e. Composition:
f. • Cement content typically ranges from 800–1000 kg/m³, which provides very high strength but increases heat of hydration, shrinkage risk, and production costs.
g. • Fine aggregates are used with particle sizes between 150–800 μm.
h. • Inert fillers such as quartz powder (0.1–100 μm) improve packing density.
i. • Supplementary cementitious materials (SCMs) can reduce costs while maintaining performance.

Steel Fibers:

Steel fibers are added to improve ductility, toughness, and crack resistance. Optimal fiber dosage is essential — concentrations above 2% by volume provide limited additional benefit due to difficulties in uniform dispersion.

Mixing Process:

The mixing procedure must be carefully controlled to achieve uniformity and performance. Key considerations include:

a. Proper sequence of adding materials.

b. • Dry mixing of binders, fillers, and aggregates before introducing water and HRWR additives.

c. • Control of mixing time (typically 15–20 minutes), speed, and temperature.

d. • Ensuring homogeneous dispersion of fibers throughout the matrix.

3.4.3.4 Mix Proportioning and Mechanical Characterization

It is important to note that **Ultra-High Performance Concrete (UHPC)** does not contain coarse aggregates. Instead, it relies on fine powders and fibers to achieve very high strength and durability. A typical proprietary UHPC mix is shown in the Figure 3-3 and Figure 3-4 below:

Sl. No.	Material	Kg/M^3
1	Fine Sand	1050
2	Portland Cement	1000
3	Silica Fume	231
4	Ground Quartz	211
5	Steel Fibres	160
6	High Range Water Reducer (HRWR)	32
7	Accelerator	35
8	Water	109
Total		**2828**

Table 3-1 Typical composition of proprietary UHPC mix

Sl. No.	Product	Conventional Concrete (CC)	High Performance Concrete (HPC)	Ultra – High Performance Concrete(UHPC)
1	Compressive strength(MPa)	5-50	50-120	120-250
2	Density(Kg/m3)	2300	2500	2900
3	Flexural strength h(MPa)	1-5	4-14	14-29
4	E-Modulus(GPa)	20-40	50-60	70-80
5	Thermal-Conductivity(W/mK)	2.0	1.5	1.5
6	Coeff. Of thermal expansion (K-1)	10x10-6	10x10-6	10x10-6

Table 3-2 Comparison of mechanical properties: CC vs HPC vs UHPC

Figure 3-3 Photo of UHPFRC U Girder casted at site

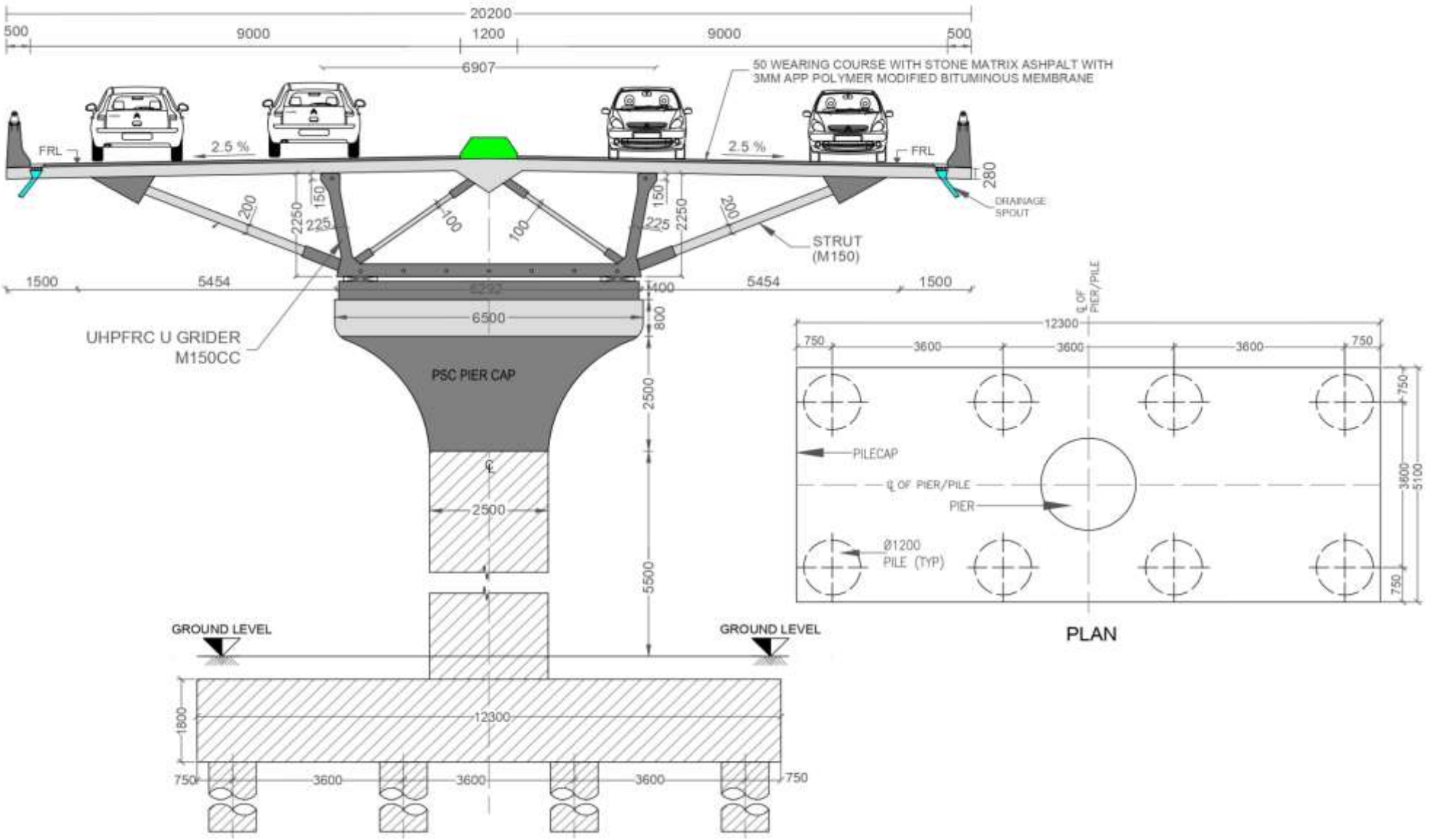


Figure 3-4 Section of UHPFRC Strutted box Girder for 20.20m width

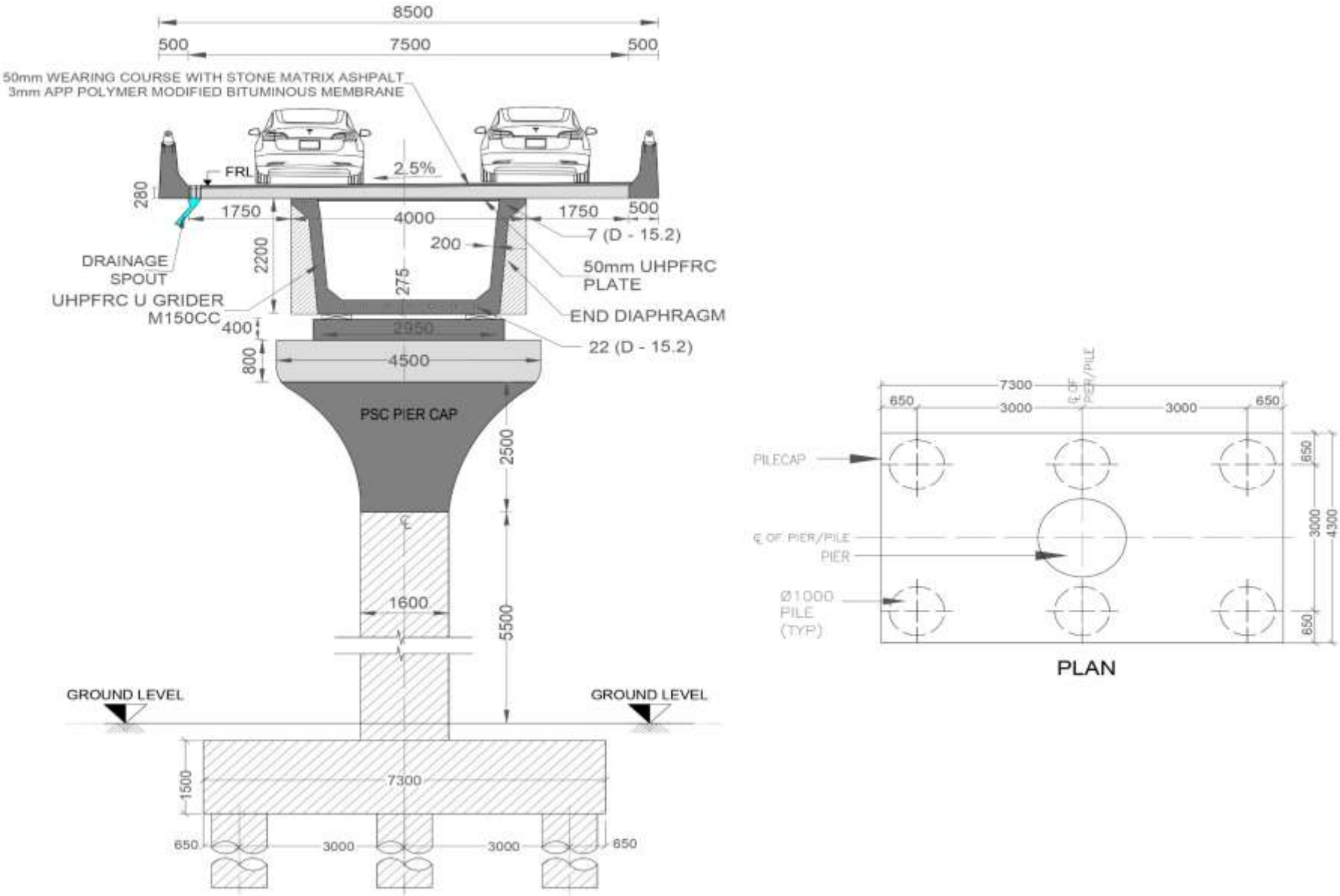


Figure 3-5 Section of UHPFRC U Girder for 8.5m width

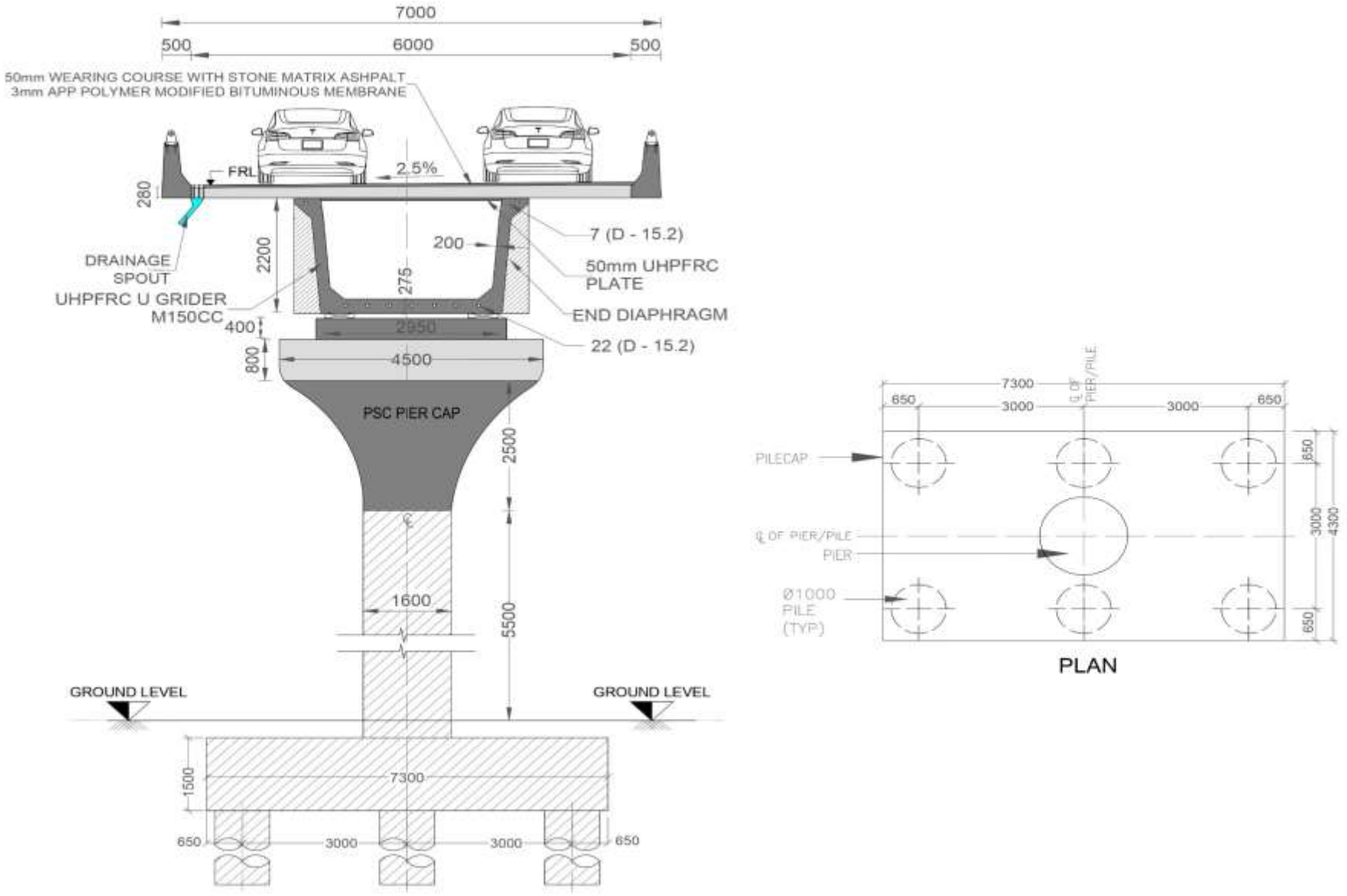


Figure 3-6 Section of UHPFRC U Girder for 7.0m width

UHPFRC (Ultra-High-Performance Fiber-Reinforced Concrete) is an emerging material in bridge and flyover construction, valued for its superior mechanical properties and durability compared to conventional concrete. When combined with a strutted box girder design, UHPFRC offers several advantages: increased strength and stiffness, enhanced service life, potential for longer spans, improved aesthetics, and reduced construction time.

For this project, a UHPFRC U-box girder has been adopted for the 8.5 m carriageway, requiring a pier cap size of 6.5 m. For the 20.2 m carriageway, however, a UHPFRC strutted box girder has been selected, which accommodates the same width with a pier cap size of only 7.0 m effectively halving the pier cap length compared to a U-box girder.

Due to its extremely high compressive and flexural strength, UHPC allows for smaller cross-sections with significantly reduced dead weight. Although UHPC is denser than conventional concrete, its flexural strength is several times higher, enabling lighter overall structures. Higher modulus values also mean reduced deflections compared to CC or HPC.

A comparative study shows that a 30 m span, 20.2 m wide segmental precast box girder requires a depth of 2.2 m, while a 45 m span, 20.2 m wide UHPFRC U-girder achieves the same depth of 2.2 m. This demonstrates that UHPC enables longer spans without increasing girder depth. The resulting reduction in dead weight proportionally decreases forces on the substructure, leading to savings in foundation size and cost.

Recommendation: For longer spans in urban flyovers, UHPFRC strutted box girders provide an ideal solution, combining efficiency, durability, and economy while minimizing substructure requirements.

3.4.3.5 Limited use of UHPFRC

Despite its many advantages, Ultra-High Performance Fiber-Reinforced Concrete (UHPFRC) has limited application in India at present. The reasons include:

a) High Cost and Proprietary Supply

i. UHPC is currently available in India only as a proprietary product, supplied by a few firms in pre-packed bags ready for mixing.

ii. This restricted supply chain results in very high costs, presently around ₹1,00,000 per cubic metre, making widespread adoption economically challenging.

b) Lack of National Design Standards

i. While countries such as France and Switzerland have developed detailed codes covering UHPC material specifications, testing, execution, and design standards, India has yet to establish comprehensive guidelines.

ii. The absence of Indian Standards (IS) or IRC-based design provisions is a major hindrance, as engineers and contractors lack formal references for design, quality control, and compliance.

3.4.3.6 NHAI Notification for Use of UHPFRC Structural elements

The National Highways Authority of India (NHAI), through Circular No. RW/NH-33049/01/2020 : S&R (B) Pt dated 22 February 2022, has emphasized the use of UHPFRC girders for longer spans of 50–100 m, compared to traditional girder systems typically limited to spans of around 30 m.

The Authority has recognized several advantages of UHPFRC girders:

a) Faster construction timelines.
b) Substantial savings in substructures and foundations.
c) Longer durability and service life.
d) Reduction in carbon footprint when applied to longer spans.

To promote adoption, the Government has permitted consultants to introduce modern UHPC structural elements in upcoming DPRs, particularly for National Highway viaduct projects exceeding 2000 m in length in urban areas, subject to evaluation of economic implications.

Furthermore, the Government has relaxed the application of conventional Indian codes for UHPFRC until specific IS/IRC standards are published. Concessionaires and EPC contractors are allowed to incorporate UHPFRC technology even in ongoing projects tendered prior to the circular, where conventional precast systems were originally specified.

Based on this national policy direction, the State Government can confidently align with the same approach, ensuring the best use of advanced technology for faster, more durable, and sustainable elevated infrastructure.

3.5 Recommendation of Structural elements for super structure

In order to achieve longer span bridges, Ultra-High Performance Fiber-Reinforced Concrete (UHPFRC) has proven effective in meeting design requirements compared to conventional reinforced concrete systems. By enabling spans of 50–100 m, UHPFRC reduces the number of foundations required. Since foundation works are among the most time-consuming activities in any project, this reduction provides a significant advantage in terms of construction speed and overall project delivery.

With these benefits—fewer foundations, faster construction, improved durability, and reduced carbon footprint—combined with the guidance of the NHAI Circular (22 February 2022) encouraging the use of

UHPFRC girders, it is recommended that this methodology be adopted for the elevated corridor project. Accordingly, UHPFRC girders have been selected for implementation in this project.

3.5.1 Comparison of Cost by use of UHPFRC and HSC Concrete

Before recommending the structural elements for the superstructure, a comparative study was undertaken to evaluate potential savings in both cost and construction time. The analysis clearly demonstrates that adopting UHPFRC girders results in significant advantages over conventional alternatives.

As shown in Table 3.3, the use of UHPFRC girders provides:

a) Cost savings of approximately 15–16% compared to traditional systems.
b) Substantial reduction in foundation requirements, including piles and pile caps.
c) Reduction in substructure components, such as piers and pier caps.

These reductions not only lower direct construction costs but also shorten project timelines by minimizing foundation works, which are typically the most time-consuming activities in bridge construction.

Sl. No.	Description	UHPFRC Girder	HSC Box Girder	Savings wrt HSC Technology in terms of Number	Remarks Savings in %
1	Length of viaduct in Mtr including 20.2m, 8.5m & 7.0m Carriageway Excluding approach	6746	6746		
2	Span arrangement in Mtr	45	30		
3	Structure Area (Viaduct+Approches)	76561.40	76561.40		
4	No of Pile	604	1020	416	41%
5	No of Pile cap	151	224	73	33%
6	No of Pier	151	224	73	33%
7	No of Pier cap	151	224	73	33%
8	Concrete Quantity for Girder / Meter length	7.0cu/Rm for 20.2m Strutted box 2/RM for U Girder	12 /RM for 17m CW & 8 /RM for 8.5m CW		
9	Grade of Concrete for Girder	M-150	M-50		
	Description			**Savings wrt HSC Technology**	

Sl. No.		UHPFRC Girder	HSC Box Girder	in terms of Number	Remarks Savings in %
10	Unit cost for the project	Based on KPWD CSR 2023-24 with the order of continuation for the year 2025-26			
11	Unit rate for Girder concrete Quantity / Cum	Rs. 1,05,000 excluding HT Strands Rate analysis as per KPWD / Railways / CPWD SOR	Rs 34835 As per KPWD SR		
12		Amount in Cr		Savings in cost by adopting UHPFRC Technology	Savings in %
		UHPFRC Technology	PSC Conventional Technology		
13	Pre- construction Activities, Site Clearance & Dismantling	3.45	3.45	0.00	0%
14	Foundation (Pile &Pile cap)	147.35	216.26	68.91	32%
15	Sub Structures (Pier & PSC Pier cap)	35.31	56.03	20.71	37%
16	Super Structures (UHPFRC - U Girder)	302.70	396.07	93.37	24%
17	Reinforced Earth Approach ramps to super structures (RE Wall)	4.51	451	0.00	0%
18	Wearing Coarse for super structures (SMA)	4.94	4.94	0.00	0%
19	Finishing items for super structures (Crash Barrier, painting, Handrail etc.)	9.28	17.62	8.33	47%
20	Streetlight over flyover	2.43	2.43	0.00	0%
21	Noise Barrier for controlling noise on flyover	3.41	3.41	0.00	0%
	Description			**Savings wrt HSC**	

Sl. No.		UHPFRC Girder	HSC Box Girder	Technology in terms of Number	Remarks Savings in %
22	Reconstruction of White topping road at approaches	13.31	13.31	0.00	0%
23	Restoration of existing road after completion of flyover construction and Rainwater Harvesting	3.15	3.62	0.47	13%
24	Re construction of Compound wall at LA Location for Government and private properties	1.91	1.91	0.00	0%
25	Credit for Dismantled Material: Deduct Salvage values from Dismantled structures like SSM masonry (scarp material Steel 151.55 MT (from Existing ROB structures, RE Wall) RE earth from Dismantled Existing RE wall structures 60% of existing earth is considered for reuse during new RE wall structures.	-0.01	0.01	0.00	0%
26	Design charges @ 0.5% on total of above items 2 to 9 as per SR V-1 Sl. No. 1 Page 117 as it is EPC contract	2.55	3.51	0.96	27%
27	Maintenance charges for stand-alone projects like Bridge/ Tunnel /flyover works: the contractor shall be paid @ 0.25% of the Contract Price each for the first five years and @ 0.50% of the Contract Price each for the remaining period of five years. on total of items as per MORTH Ltr No.RW/NH-37010/4/2010-EAP(Printing) Vol.-IV Government of India Ministry of Road Transport & Highways Dated: 05.03.2019 AT Model agreement page 76 under section 14.1 d	4.01	5.45	1.45	27%
28	**Amount Put to Tender (Civil Construction Cost)**	538.28	732.49	194.21	27%
29	GST @ 18% on Amount Put to Tender	96.890	131.848	23	17%

Sl. No.	Description	UHPFRC Girder	HSC Box Girder	Savings wrt HSC Technology in terms of Number	Remarks Savings in %
30	Provision for Contingencies and Provision for Departmental Establishment Charges @ 2% on APT.	10.77	14.65	3.88	27%
31	Provision for Independent Engineer / PMC/DPR @ 1.50% on APT	8.07	10.99	2.91	27%
32	Provision for Price escalation @ 2.5% for the 2nd year i.e., 2.5% on APT	13.46	18.36	4.86	27%
33	Provision for utility shifting @ 8% on APT	43.06	58.60	15.54	27%
34	Provision for Arboriculture/ Afforestation @ 0.50% on APT	2.69	3.66	0.97	27%
35	Land Acquisition Cost including Structures	96.40	96.40	0.00	0%
36	Miscellaneous and other Department Deposits	0.38	0.38	0.00	0%
37	**Total Project Cost**	810.00	1067.32	257.32	24%
38	Estimated cost : Interms of Structural area in Sqmt Area and in terms of Km wise	UHPFRC		HSC Girder	
39	Cost/Sqmt (Structurer Area 72156.4.40 sqmt) for structure alone (considering Foundation + sub + super structure + RE Wall approaches + Finishing + Lighting + Wearing course) = Rs.69860/sqmt for UHPFRC and Rs 96377/Sqm for HSC Grade	On Amount Put to Tender	On Total Project Cost	On Amount Put to Tender	On Total Project Cost
40	Cost/Sqmt Sl No 28 / Sl No-3	74599	112256	101514	147918
41	Cost/Km Viaduct length 6.572 + Approach 0.565km Total Length (including single lane loops + fourlane + single lane approaches) = 7.137 km (equal to four lane Carriage Way is 5.3Km)	80	120	109	158

Table 3-3 Cost comparison between using UHPFRC Girders and HSC Box girders

3.6 Design Standards

3.6.1 Planning of Geometry and Structural Design Standards

Planning criteria for elevated flyovers, as outlined by the Indian Road Congress (IRC), include considerations for traffic analysis, design speed, road width, and vertical clearance. These criteria ensure safe and efficient traffic flow and adhere to standards for urban areas.

3.6.2 Geometry

The objective of geometric design is to provide maximum efficiency in traffic operations and maximum safety at reasonable cost. The horizontal geometry shall be designed in accordance with IRC 86 -1983. However, the Geometry in urban areas mainly depends on site conditions like modifying geometry of alignment at existing structure, to maintain existing road profile, restriction of width due to building lines etc.,

3.6.3 Carriageway Width

i. The carriageway width for four lane shall be provided as per the provisions of IRC Codes for the traffic requirements as determined by traffic census and studies.

ii. The carriageway width on the elevated structure shall be kept same as on the approaching roads on both side and the widths shall not be reduced abruptly under any circumstances.

3.6.4 Design Speed

Design speed is related to the function of a road. Keeping in view the type of road considering for the project road as sub arterial/collector Street as per the urban road with mixed traffic system, the design speeds of 40 kmph is adopted.

3.6.5 Horizontal Curves

Horizontal curves should consist of a circular portion flanked by spiral transitions at both end. Design speed, super-elevation and coefficient of side friction affect the design of circular curves. Length of transition curves is determined on the basis of rate of change of centrifugal acceleration and super-elevation. Horizontal curves, are designed in accordance with I RC: 38 1988.

3.6.6 Widening at Curves

Wherever horizontal curves are provided in Grade separators, the carriageway is widened as per relevant codes. The structures having entry and exit ramps are provided with adequate length of acceleration/deceleration/merging lanes to ensure free and safe flow of traffic and to avoid congestion near the mouth of such ramps resulting in traffic jams.

3.6.7 Sight Distance

Adequate stopping sight distance shall be provided at all points on the road in conformity with IRC standards for 40Kmph 60m Sight distance is proposed:

3.6.8 Clearances at Elevated Structures

The minimum horizontal clearance shall be the clear width and the minimum vertical clearance the clear height available for the passage of traffic. The minimum vertical clearance of any structure provided over the project road shall be 5.0 m for non-urban areas and 5.5 m in case of urban areas. In case of structures over local or collector streets, where only light commercial vehicles are plying and where alternative routes for heavy commercial vehicles and fire tenders are available within a short distance, this may relax the clearance requirements of 5.5m. At locations where over-dimensional vehicles are frequently plying, will consider providing increased vertical clearance. The minimum horizontal and vertical clearances for single and multiple lane bridges with vehicular traffic shall be followed as per the provisions of IRC: 5.

3.6.9 Super-elevation

Super-elevation shall be provided on a horizontal curvature in accordance with the relevant IRC Codes. The effect of super elevation on stresses in the various members of the structure shall be taken into account in the design. Super-elevation shall be limited to 7 percent. However, as the project road is in urban sections with frequent intersections, it may be limited to 4 percent.

3.6.10 Gradient and Profile

The Gradients in the approaching viaducts or earth embankments shall usually be limited to as per the relevant provisions of IRC codes 92-1985. However, in situations where sufficient space or length is not available then the gradients may be locally increased to meet the requirement after judiciously considering the type of traffic using the facility. For vertical gradient for ramps will be limited to 4% as per site condition and will not be exceed 6%.

3.6.11 Drainage

Effective drainage shall be ensured by providing drainage spouts connected with horizontal and vertical pipe system such that the water from the structure does not fall on the roads, does not stagnate over the roads or at entry and exit points of the grade separators and is discharged into the overall draining system devised for the project area.

3.6.12 Camber

Camber shall be provided as per relevant IRC codes. Camber on grade separator with high type bituminous surfacing or cement concrete surfacing should be 1 .7 to 2 .5 percent. The camber of 2.5% is proposed in deck and approaches.

3.6.13 Railings, Parapet or Crash Barriers

Railings or parapets shall be provided on both sides of the bridge for the protection of traffic. Apart from its structural strength considerations shall be given primarily to the architectural features of the railing or parapet to obtain proper proportioning of its various elements to harmonies with the structure as a whole. Consideration shall also be given to avoid, as far as is possible obstruction of the view from the passing motor cars.

Crash barriers shall be provided for grade separators designed for high speed vehicles particularly project roads in urban areas. Crash barrier of concrete is provided.

3.7 Design Standards of Structures.

Design of Elevated Corridor shall be carried out as per relevant IRC standards.

3.7.1 Materials of Construction & Specifications

The material for the grade separators is generally concrete.

One of the considerations in selecting the concrete material is that construction should be possible without causing too much inconvenience to the existing traffic for a long time. Use of Ultra High performance of Fiber reinforced Concrete of M150 to M 200 is proposed to make the structure look slim and more durable.

3.7.2 Loads

Loading standards shall be in accordance with IRC: 6. for grade separators of 2 lanes and above, live load categories as defined in IRC: 6 is adopted.

3.7.2.1 Bumper to Bumper Traffic

In crowded towns, vehicles have to stop at traffic signals or on account of traffic jams. In such cases vehicles may be standing bumper to bumper on grade separators. The effect of this loading should also be considered in the design. Proposed to design as per IRC-Class A vehicle.

The crash barriers of concrete is proposed to be provided for grade separators designed for use by high speed vehicles in urban areas just after the ends of carriageway. The loading and design criteria for crash barriers shall be as per 1RC; 6.

The foundations shall be designed to withstand the worst combination of loads and forces evaluated in accordance with the provisions of Clauses 700 and 707 of IRC: 78. The foundations shall be taken to such

depths that they are sufficient from consideration of bearing capacity, settlement, stability and suitability of strata at the founding level and sufficient depth below it.

The part of the grade separators falling in line of traffic will be designed for collision loads and impact as per IRC:78

3.7.3 Minimum Dimensions

The minimum dimensions of various members or components shall follow the provisions of relevant IRC Codes. Using the new technology of UHPFRC, the thickness of the structural components based on IRC loading depends on the actual design and is certified by the authority before implementation.

3.7.4 Design for Continuity

The continuity of the superstructure is achieved by providing full continuity or continuity for live load only. This is achieved by providing superstructure longitudinally continuous over intermediate supports on bearings.

Segmental box girder bridges are typically designed with a U shaped box- cross-section, often using pre stressed concrete, steel/steel fiber, or a combination of both. Geometric design considerations include span lengths, box dimensions (width, depth, and length of segments), and the arrangement of cells within the box. Structural design focuses on ensuring the bridge's stability, durability, and ability to withstand loads, considering factors like span-to-depth ratios, material properties, and connection details.

The detail and the design proposal followed for this project of elevated corridor is summarized in the Table 3-4 below.

Sl. No.	Details	Description
1	Proposal of carriageway	Four lane divided carriageway
2	Overall Width of bidirectional Carriageway	Proposed width is 20.2m
3	Overall width of unidirectional Carriageway/Merging or Diverging Loop	Proposed width is 8.5 m/7.0m
4	Width of RE wall approaches for diverging/merging Carriageway	Proposed width at up ramp for RE Wall approach is 7 m for a shorter length of 100m is proposed as per site condition to avoid the acquisition of existing multistoried buildings
5	Length of Project road as per GO	3.50 km
6	Proposed length of Elevated Corridor including loops and all approaches	5.220 Km
8	Type of Structure	Elevated Corridor as flyover with RCC Structures

Sl. No.	Details	Description
9	Intermediate Span of elevated corridor	Longer Span of 45m at straight stretch and 35 m curve and cantilever portion is proposed
10	Type of Foundation	RCC Pile foundation with Bored Cast in situ piles as per IRC
11	Type of substructure	Circular pier with pile cap structure. Circular pier. PSC Pier cap at the top of pier for elevated structure.
12	Type of Bearing	POT Cum PTFE/ Elastomeric Bearing
13	Type of Girder with deck slab	Precast segmental strutted UHPFRC/ U type box girder with open cross-section with Post tension.
14	Segmental Construction	A typical segmental box girder is designed with a length of approximately 5.0 m and a depth of 2.2 m, excluding the deck slab thickness of 250 mm. The cross slope is generally provided at 2.5% to facilitate surface drainage.
15	Launching methodology	**1. Span-by-Span Method** Each segment is placed sequentially and stressed span by span, ensuring controlled alignment and stability during construction. **2. Pre-Assembly and Lifting Method** After all segmental girders are assembled and stressed on the ground, a 150–200 MT capacity crane can lift a single girder unit and place it directly on the pier cap.
16	Type of Pier cap	Pre cast pier cap of High strength concrete
17	Load consideration	
18	Permanent Loads (Dead Loads):	Self-weight of the structure: The weight of the box girder and deck slab
		Superimposed Dead Loads (SIDL): Loads from components like railings, barriers, medians, and wearing courses.
19	Live Loads (Traffic):	Vehicular Live Loads: Loads from traffic moving on flyover, including both normal and crosswise loading. IRC (Indian Road Congress) IRC: 70R & Category AA: Specific live load categories used in Indian standards.
20	Type of other loads considered for design	Temperature Loads Post-Tensioning Loads Construction Loads
21	Load Combinations: The design will consider various load combinations, including DL, SIDL, post-tensioning, and live load, to ensure the structure can safely withstand all anticipated loads.	DL (Dead Load): The weight of the structure itself. SIDL (Superimposed Dead Load): Loads from elements like railings and barriers. Secondary Pre-stressing parameter: Loads related to the post-tensioning system. LL (Live Load): Loads from traffic.

Sl. No.	Details	Description
22	Grade of Concrete for Box girder	UHPFRC M-150-200 Concrete
23	Grade of Concrete for Pier cap & Pier	M 35
24	Grade of Concrete for Pile and Pile cap	M-35 Concrete
25	Grade of Pre stress strands	Low -relaxation strands: These strands are chosen for their ability to maintain a stable level of pre stress over time, minimizing relaxation (loss of stress) due to creep and other effects.
26	Type/Grade of Reinforcement	Copper coated Steel Fiber for girders /Fe 500 for foundation/substructures/deck slab
27	Various types of Permissible stress	For segmental box girders, permissible stresses as per applicable country/IRC codes, specifically IRC SP 65-2005 and IRC 112-2011, are primarily focused on ensuring structural integrity and safety during various stages, including construction, handling, and service life.
28	Wearing Coat	The wearing coat shall be provided over the deck to resist traffic wear and to provide a smooth riding surface. The type of the wearing coat is Stone Matrix Asphalt. Before laying Wearing coat, Waterproofing of deck slab shall be carried out using 3 mm thick APP polymer-modified bituminous membrane reinforced with polyester, torch-applied over a primed concrete surface, conforming to IRC/MoRTH specifications.

Table 3-4 Showing Design Proposal

3.8 Approaches to Elevated structures in Urban Locations

The project road is in urban areas sufficient width is not available and wider roads & drains are required on all sides. Earthen banks also require considerable quantity of earth which has to be brought from long distance & the cost is also more. Considerable costly land is occupied by the approaches. Solid earthen embankments also obstruct the view and do not look good.

As such earthen approaches are not considered in this project road. Viaduct spans up to a height of 5.0 m is extended so that in the last span a vertical clearance of 3 to 3.5 m is available. This may be followed by retained embankment either by retaining walls or reinforced earth walls.

3.8.1 Retaining Walls and Return Walls

Reinforced Soil Structures is proposed as Retaining wall and to protect the earth at the last span of viaduct to retain the earth.

i. Reinforced earth retaining walls constructed with soil backfill reinforced with inextensible flexible reinforcement, such as metallic strips or sheets or extensible geo synthetic materials, such as; geo-textiles and geo-grid, are used for solid ramp portion for approaches of flyovers, grade separators and or embankment. It does not cover load bearing abutments.

ii. Selected fill and filler material conforming to specifications given in relevant IRC standards are used in the reinforced soil structure as back fill behind fascia panels. The material is granular and purely non-cohesive.

iii. Geo-synthetic material may be woven, non-woven or knitted sheet used in geo-technical engineering and other civil engineering applications that sustain design loads at permissible strains and defined creep characteristic with maximum elongation less than the permissible limit.

iv. Metallic reinforcement is in the form of strip or rod or square welded mesh/ net which sustains load at strains less than or equal to the permissible value.

v. The facia panels should be cast with proper line and finish preferably in a casting yard. They can be given different treatment with patterns to suit the aesthetical requirements or giving any effect.

vi. The back fill material should be properly compacted in the designed thickness of layers, as per the specifications.

vii. The facia panels should be erected to give uniform surfaces and fixed to the reinforcing materials such that these are not dislodged.

viii. The drainage layer of prescribed specifications should be provided as required by design and specifications and it should be ensured that it will remain functional and will not be choked because of flow of silt particles in the backfill, during the outflow of water, as it may result in the failure of embankment.

4 Design report with Improvement Proposals.

4.1 Elevated Corridor and approaches.

Considering the present and feature growth of traffic volume and movement pattern to reduce the traffic congestion between Sirsi Circle to start of Existing Nayandahalli Flyover an elevated corridor of four lane bidirectional flyover is proposed.

4.1.1 Proposal from Starts to End of Project road

The project road starts from Sirsi Circle and ends at Nayandahalli. The total length of Project Road is 5.220 km as per concept plan prepared with marking of chainages. Description of the start and end of the elevated structure is described in the table below.

Details of proposal for the proposed elevated corridor

Sl. No.	Description	Chainage		Length in Km	Width in m
		From	To		
1	Proposed loop of Single Lane Flyover from existing Balagangadharanatha Swamy Flyover to Kudhure Park (LHS) including merging Tapering length. Length of Viaduct = 968m	0+000	0+968	0.968	8.50
2	Proposed loop of Intermediate Lane from existing Balagangadharanatha Swamy Flyover to Kudhure Park (RHS) including Tapering length of diverging / Merging. Length of Viaduct = 968m	0+000	0+968	0.968	8.50
3	Proposed intermediate Lane from Gopalan Mall to Sirsi Circle (RHS) Length of Approach=65m, Length of Viaduct=473m	0+430	1+968	0.538	7.00
4	Proposed 2 Lane Flyover approach from Kudhure Park to Gopalan Mall (LHS) Length of Approach = 100m, Length of Viaduct = 100m	0+695	0+895	0.200	8.50
5	Proposed 4 Lane Flyover from Gopalan Mall to Gali Anjaneya Temple to BHEL Junction near Vrishabhavati River Bridge Length of Viaduct = 1822m	0+968	2+790	1.822	20.20
6	Proposed tapering intermediate Down Ramp near Bytarayanapura Police Station to BHEL Junction near Vrishabhavati River Bridge Length of Approach = 100m, Length of Viaduct = 250m	2+405	2+755	0.350	7.00
7	Proposed 2 Lane Flyover from BHEL Junction near Vrishabhavati River Bridge to Existing Nayandahalli Flyover (Indian Oil Petrol Bunk) Length of Approach = 100m, Length of Viaduct = 560m	2+790	3+450	0.660	8.50
8	Proposed 2 Lane Up Ramp from K.S.R.T.C Bus Depot No. 5 to BHEL Junction near Vrishabhavati River Bridge Length of Approach = 100m, Length of Viaduct = 170m	0+000	0+270	0.270	8.50
9	Proposed 2 Lane Up ramp Loop from Vijayanagara to Proposed Flyover near Sri Gali Anjaneya Swami Temple Junction Length of Viaduct = 460m	0+000	0+460	0.460	8.50
10	Proposed intermediate loop lane Flyover from BHEL Junction to NICE Road Length of Approach = 100m, Length of Viaduct = 410m	0+00	0+510	0.510	7.00
Total length of Elevated Corridor				**6.746 Km**	
Total length of Approach				**565.00m**	
Total Length of Viaduct				**6181.00m**	
Total area of Viaduct				**72156.4Sqm**	
Total Area of Approach				**4405.0Sqm**	
Total Area including Viaduct & Approaches				**76561.40Sqm**	

4.1.2 Features of Elevated Corridor

Number of Lane	: 4 lanes Bidirectional / 20.2m width
Minimum Carriageway Width	: 2 x 7.5 m
Median	: 1 x 1.2 m
Paved Shoulder	: 2 x 1.5 m
Crash Barrier	: 2 x 0.5 m
Single Lane over all width	: 1 x 8.5 m
Single Lane Loop over all width	: 1 x 7.0 m (CW = 5.5m + Shy 2 x 0.25 + Crash 2 x 0.5)
Minimum Vertical Clearance	: 5.5m (Varies as per site condition)
Minimum Radius of Curve	: 70m
Viaduct Span for straight reach	: 45m for 20.2m Carriage Way
Viaduct Span at Curve location	: 35m for 20.2m Carriage Way
Viaduct span for 8.5m Carriage Way	: 45m with cantilever pier cap
Vertical clearance for second level structure	: Minimum 5.5m
Supporting structure at split section / wider	: Portal frame with UHPFRC I Girder as beam
Type of Box Girder	: Segmental UHPFRC U Girder for 8.5m and Strutted Box Girder for 20.2m
PSC Pier Cap	: For 8.5m and 20.2m.
Foundation	: Deep Pile foundation
Entry / Exit Ramp	: with RE Wall approach

4.2 At Grade Road improvement

The 3.20 km long at-grade road starts from the metro station on Sirsi Circle to Nayanadahalli is constructed with thin white topping and the buffer zone between the edge of the CC road and the sidewalk is paved with cement concrete pavers. The center of the road is bisected with a centerline of 0.5 m median.

When an elevated structure is started for construction, the central section of 3 meters width is continuously barricaded and utilized for the construction of foundation and substructure works within the site. An additional 2 meters of space will be used in addition to the 3 meters at each pier location. During construction, at some places, the CC road and pavers laid in the buffer space between the CC road and the sidewalk in the middle will be damaged.

The restoration of White thin topping and reconstruction of CC pavers along with foot path pavers is included in the estimate. Apart from this reconstruction of road on approaches and widening is proposed wherever necessary and additional provision for overlay of 40mm Bituminous Concrete (BC) and 60mm of Dense Bituminous Concrete (DBM) used for profile correction to correct the undulations including

desilting of the existing drain with repairs at damaged locations. Apart from this new construction of road for 1.50 Km is considered in the estimate for providing service road on approaches at NICE Road, BHEL Junction, Kudhure Park and Sirsi Circle adjoining to Police Housing property.

4.3 Proposed for Land Acquisition

The area of acquisition of private land and property of Government entities required for acquisition is listed in Table 4-1below:

Part No	Chainage in m		LA Map Name & No.	CTS No.	Type of Land	Area in Sqmt	Area in Acres	Affected Structures	
	From	To						Type	Area in Sqmt
1	0.00	400.00	Goripalya - 53	386	Government Land (Karnataka Police Housing Corporation)	2148.96	0.531	RCC	38.11
								G+1	179.24
2	100.00	150.00	Azad Nagara - 49	-	Private Land	16.37	0.004	RCC	31.05
3	640.00	690.00	Azad Nagara - 49	-	Private Land	91.46	0.023	RCC	84.58
4	695.00	810.00	Valmiki Nagara - 50	1	Government Land (GBA Park)	1058.06	0.261	-	-
5	815.00	855.00	Valmiki Nagara - 50	763	Private Land	229.11	0.057	G+1	54.60
				763				G+1	55.30
				764				Sheet	75.05
				764				Sheet	62.60
6	895.00	916.00	Valmiki Nagara - 50	763	Government Land	85.85	0.021	RCC	1.90
								G+1	49.40
								G+1	65.80
7	2450.00	2560.00	Avalahalli - 17	115, 116, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145 & 146	Private Land	255.33	0.063	G+2	53.40
								RCC	7.20
								G+2	60.15
								G+2	85.20
								G+3	81.08
								G+1	82.96
								Sheet	35.67
								G+3	190.08
								G+2	83.40
								G+1	33.14
								Sheet	28.06
								G+2	45.48
								G+2	35.28
8	2500.00	2740.00	Bapujinagara - 16	620, 621, 622, 623	Government Land (Karnataka Vidyut Karkhane)	2322.17	0.574	G+1	1886.76
								G+1	918.00
9	2420.00	2500.00	Bapujinagara - 16	627, 628	Government (KIADB / NICE)	3895.53	0.963	-	-
10	2575.00	2650.00	Bapujinagara - 16	682	Government Land (K.S.R.T.C Bus Depot)	501.02	0.124	RCC	14.70
11	2900.00	2990.00	Bapujinagara - 16		Private Land	730.04	0.180	Sheet	76.57

Part No	Chainage in m		LA Map Name & No.	CTS No.	Type of Land	Area in Sqmt	Area in Acres	Affected Structures	
	From	To						Type	Area in Sqmt
				630, 631, 661, 632, 634, 635, 639, 640, 641, 642				Sheet	75.15
								Sheet	40.56
								Sheet	16.60
								BS+G	99.68
								BS+G+2	263.24
								BS+G+3	181.95
								BS+G+2	338.16
								G+3	161.24
								G+1	79.90
12	3050.00	3100.00	Bapujinagara - 16	681	Private	412.63	0.102	Sheet	30.23
								Temple	23.93
13	3050.00	3150.00	Bapujinagara - 16	663	Private	159.2	0.039	RCC	74.95
								G+2	131.49
								G+3	157.56
								Sheet	38.39
								BS+RCC	26.36
14	2730.00	2775.00	Bapujinagara - 16	680	Government Land (B.H.E.L)	230.11	0.057	Sheet	17.14
15	2705.00	2830.00	Bapujinagara - 16	663	Private	154.01	0.038	G+3	237.80
								G+2	152.31
								Sheet	21.19
16	2920.00	2990.00	Bapujinagara - 16	663	Private	206.38	0.051	-	-
17	2990.00	3120.00	Bapujinagara - 16	668, 663	Private	262.46	0.065	-	-
					Total	**12758.69**	**3.153**	**48 Nos**	**6582.59**

Table 4-1 List of Land acquisition

ABSTRACT					
Sl. No.	**Type of Land**	**Area in Sqmt**	**Area in Acres**	**Affected Structures Area in Sqmt**	
				Private	**Government**
1	Private Land	2516.99	0.62	3411.540	3171.05
2	Government Land	10241.70	2.53		
	Total	**12758.69**	**3.15**	**3411.540**	**3171.05**

An area of 3171.05 sqmt is considered for reconstruction of assets in the Government Land at the rate of Rs.30920.00/sqmt under the category of office/ colleges as per CPWD Plinth Area Rates of 2025 which is worked out for Rs. 36,25,06,563.00 including compensation (3,171.05 x Rs. 30,920 = Rs. 9,80,48,866.00 + Rs. 26,44,57,697.00)

Land Acquisition Area

Land Value as per Registration and Stamp No. CVC/99/2023-24, Bengaluru, Dated: 27-09-2023					
Sl. No.	**Location**	**Private Land Area in Sqmt**	**Guideline Value Page No & Sl. No**	**Rate as per Guideline Value**	**Total Amount in Rs.**
1	Mysore Main Road attached from Guddadahalli to Vijayanagara Junction	2516.99	Page 56, Sl. No. 101	130000.00	654417400.00 (327208700 x 2)
	Total	**2516.99**		**Total**	**65,44,17,400.00**

An amount of Rs. 65,44,17,400.00 is reserved for Compensation of land of area 2516.99sqmt arrived based on guideline value (Registration and Stamp No. CVC/99/2023-24, Bengaluru, Dated: 27-09-2023) as Shown in the above table.

Out of the total land acquisition area of 12758.69 Sqmt Majority of the land i.e. 10214.70 Sqmt belongs to The Government i.e. Karnataka Police Hosing Corporation, GBA Park, KAVIKA, KIADB / NICE, K.S.R.T.C and BHEL. Further 2156.99sqmt of Private Land is required for construction of Elevated Corridor from Sirsi Circle to Nayandahalli. Thus an amount of Rs.1,01,69,23,963.00 is reserved for compensation of land and Reconstruction of affected Government Structures for an area of 3171.05 sqmt arrived based on guideline value (Registration and Stamp No. CVC/99/2023-24, Bengaluru, Dated: 27-09-2023.

4.4 Structural type Proposed for Elevated Corridor

Various structural arrangement options were studied for the proposed flyover based on:

- Functional requirement.
- Characteristics of subsoil.
- Facilities to be provided at grade.
- Ease in construction.
- Economy etc.
- Topography of Site condition.

Accordingly, the structural system was planned taking into account suitability of the same at the proposed location, constructability, level of impact on traffic movement during construction etc. Elevated Corridor is planned based on subsoil report.

4.4.1 Superstructure of Elevated Corridor

The type of material proposed for the superstructure is UHPFRC PSC open U box girder.

The relative thicknesses of the web, top, and bottom flanges are determined through a design process that considers factors like span, loading, and relevant design codes, as outlined by the code of applicable countries and Indian Road Congress (IRC).

An open box U girder as a supporting structure for flyover is primarily proposed to efficiently carry loads over long spans, especially in horizontal curves or situations where a shallow section is needed. The main purpose is to maximize structural efficiency by minimizing weight while maximizing flexural stiffness and load-carrying capacity, making it suitable for flyover applications.

In this Segmental U box girders, the thickness of the web, and bottom flanges is not a fixed ratio but rather a design decision based on the specific bridge's span, loading conditions, and other factors.

Web Thickness: The web thickness of the box girder is provided with 150mm for span of 45m

Bottom Flange Thickness: Minimum thickness: 1/20th of the clear web spacing at the junction with the bottom flange, or 200mm, whichever is more. Purpose is to resist tensile forces and provide additional torsional stiffness. Proposed bottom flange is designed for 200mm.

4.4.2 Substructure

4.4.2.1 Pier Cap

Cast – in situ / Precast Pier Cap is designed to be fixed as an integral part with the pier with solid concrete unit. The pier cap length is designed to accommodate the box girders. The length of pier cap is 6.5m for 20.2m Carriage way which can accommodate the Sturtted UHPFRC box girders.

The height of the pier with bottom of pier cap is based on the clearance requirement. Where vehicles have to cross below, minimum required vertical clearance of 5.5 m is ensured.

4.4.2.2 Pier

The proposed substructure is a circular pier. The circular pier provides good structural integrity and resistance to impact, while the pier cap distributes loads from the bridge deck or superstructure to the pier, ensuring a stable and even distribution of forces.

Circular piers are often chosen for their strength and ability to resist both axial loads (from the bridge deck) and lateral loads (from wind, seismic activity, or vehicle impacts). Their rounded shape allows for a more even distribution of stress compared to rectangular or square piers, especially under off-center impacts. A single pier is proposed for the four lane superstructure. A circular pier with 2.5 m is proposed.

4.4.3 Foundation

The foundation type depends on the subsoil nature and condition at the location. Bore holes taken at site were studied to get a fair idea of the subsoil composition and to decide on the suitable founding levels. Various tests conducted at the field and laboratories were reviewed to assess the subsoil composition and nature. The Soil strata at the location of construction of Elevated Corridor is very hard and stiff with Non-cohesive soil. As could be seen from the borehole drawings based on geotechnical investigation report, the hard strata could be seen below the ground at a depth of 25-30 m with N- value greater than 100.

Based on the test results, it is proposed that the foundation of the structure has to be taken deep with the purpose of attaining a bearing strata which is suitable and which ensures strictly and durability of structure.

Pile foundation of 1.2m dia is proposed with a pile group of 8 Nos, the spacing and width of the pile cap is proposed as per IRC standards.

4.4.4 Utility Relocation Plan

Proposed Project corridor is falling within the thickly populated and developed area hence all types of utilities are existing in the corridor such as Water Supply ad sewage lines (BWSSB), High Tension Power Line of 11 KV (BESCOM/KPTCL), GAS Pipeline/OFC. After consultation with concerned stake holders a lump sum provision of 8 % on the cost of Amount put to tender is reserved for shifting/reconstruction of Utilities falling within the project corridor.

5 Traffic Study

5.1 Analysis of Existing Traffic and Forecast

5.1.1 Traffic Survey between Sirsi Circle to Nayandahalli

Classified Volume Count Survey is carried out on project road from Sirsi Circle to Nayandahalli and visa versa direction. Traffic flow is two way directions with 2 lane Carriage Way and 0.6m wide median. Classified Volume Count Survey is done for one day count from morning 6 am to evening 8 pm for 14 hours to assess the volume of traffic flow. This location survey is analyzed to obtain the following traffic characteristics:

- Average hourly variation of traffic volume
- Average Composition of traffic
- Annalise the traffic capacity of the road

The project road observes bi direction flow of traffic about 63967 Vehicles (32955 vehicles from Sirsi Circle to Nayandahalli & 31012 vehicles from Nayandahalli to Sirsi Circle) in terms of PCU is 70569 covering Morning to Evening including Peak hours. Hourly counts of different types of vehicles are shown in the below table and composition of fast moving motorized vehicles is about 98.45% percent. The number of vehicles movement in hourly is shown in table 5-1 below.

Timings	Standard Buses	Mini Buses	Cars/ Jeeps	Pickup Vans/ Maxicabs	Two Wheelers	Passenger Auto	2-Axle Trucks	3-Axle Trucks	MAVs	LCVs	Goods Auto	Tractor Trailer	Bi-Cycles / Cycle Rickshaw	Hand cart/Animal Drawn	Others	Total Vehicles	Total Vehicles in PCU
06.00-07.00	100	18	139	73	295	142	27	4	2	118	70	16	50	0	0	1054	1386
07.00-08.00	159	24	660	124	389	189	45	7	0	170	93	19	65	0	0	1944	2425
08.00 - 09.00	339	87	2373	264	1040	691	45	5	0	232	40	6	141	0	0	5263	6212
09.00 - 10.00	361	45	2531	306	2253	702	27	4	0	156	66	16	33	0	0	6500	7233
10.00 - 11.00	375	29	2060	351	3219	797	14	0	0	216	114	31	30	0	0	7236	7902
11.00 - 12.00	265	68	2092	303	3148	618	17	2	2	284	114	24	25	0	0	6962	7360
12.00 - 13.00	92	2	1043	350	4818	426	36	7	0	256	84	21	51	0	0	7186	6751
13.00 - 14.00	108	5	805	283	2053	346	31	7	2	268	54	2	40	0	0	4004	4141
14.00 - 15.00	105	15	1720	189	921	368	38	6	0	268	8	15	34	0	0	3687	4149
15.00 - 16.00	190	45	1579	149	1315	308	24	4	0	162	232	11	55	0	0	4074	4480
16.00 - 17.00	160	72	1755	135	1393	436	19	7	2	118	324	23	39	5	0	4488	5045
17.00 - 18.00	135	33	2052	117	916	422	13	0	5	210	149	7	64	1	4	4128	4637
18.00 - 19.00	157	52	1184	97	1060	485	9	6	4	178	370	10	110	1	2	3725	4356
19.00 - 20.00	136	22	1190	135	1132	760	39	2	0	188	76	2	34	0	0	3716	4500
Total	**2682**	**517**	**21183**	**2876**	**23952**	**6690**	**384**	**61**	**17**	**2824**	**1794**	**203**	**771**	**7**	**6**	**63967**	**70577**

Table 5-1 Classified Volume Count of different types of vehicles

5.1.2 Peak Hour Traffic

Peak hour traffic of bidirectional vehicles flow at 10 am to 11 am is estimated as 7236 vehicles per hour (7902 PCU). The graphical representation of peak hour traffic flow is shown in Figure 5-1below.

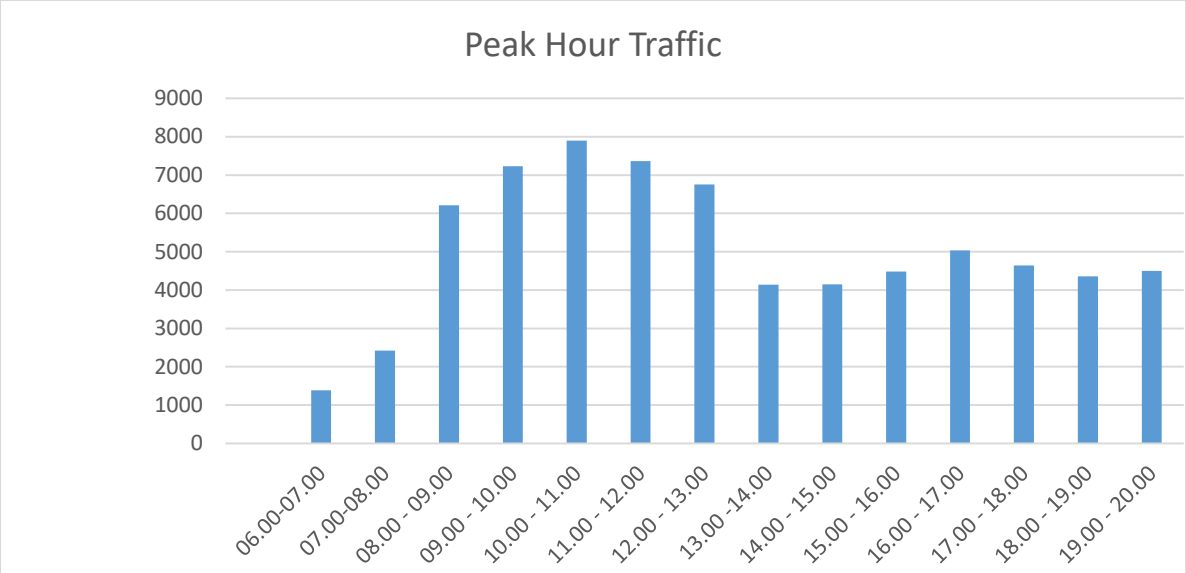


Figure 5-1Hourly Movement of Vehicle

5.1.3 Composition of Traffic

The composition of traffic has been assessed from the traffic analysis and is represented in the following **Figure 5-2**.The two wheeler vehicle composition is 23952 and composition of Car is about 21183 which is next to two wheeler.

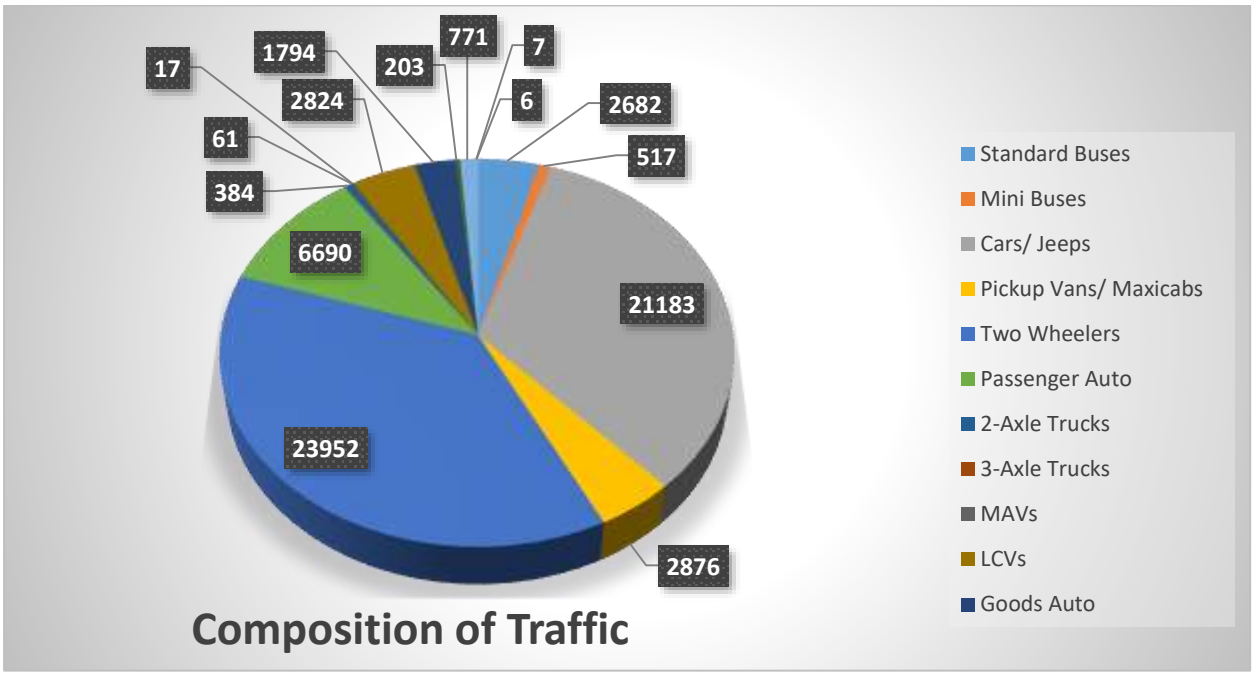


Figure 5-2 Graphical Representation of Composition of Traffic

5.1.4 Growth of Traffic

From the CVC traffic study, the traffic growth is estimated on an hourly basis and the results were tabulated. Traffic growth in PCU is estimated for 25 years at 5-year intervals. The annual growth percentage of different types of vehicular traffic is assumed and tabulated in the following statements shown in Table 5-2 and Table5-3 Assumption of Annual percentage growth of various types of vehicular traffic.

Type of Vehicles	Standard Buses	Mini Buses	Cars/ Jeeps	Pickup Vans/ Maxicabs	Two Wheelers	Passenger Auto	2-Axle Trucks	3-Axle Trucks	MAVs	LCVs	Goods Auto	Tractor & Trailer	Bi-Cycles / Cycle Rickshaw	Hand /Animal Drawn	Others
Growth of Vehicle	4%	4%	5%	5%	4%	4%	1%	1%	1%	2%	3%	1%	1%	1%	1%

Table 5-2 Assumption of Annual percentage growth of various types of vehicular traffic

Time (Hours)	Present Traffic 2025-2026	Growth for 5 Years	Growth for 10 Years	Growth for 15 Years	Growth for 20 Years	Growth for 25 Years
		2027-2032	2033-2038	2039-2044	2045-2050	2051-2056
Time(Hours)	Total Vehicles in PCU	Total Vehicles in PCU	Total Vehicles in PCU	Total Vehicles in PCU	Total Vehicles in PCU	Total Vehicles in PCU
06.00-07.00	1386	1633	1874	2116	2355	2595
07.00-08.00	2425	2888	3348	3809	4270	4724
08.00 - 09.00	6212	7527	8834	10144	11451	12760
09.00 - 10.00	7233	8776	10315	11856	13394	14933
10.00 - 11.00	7902	9544	11182	12820	14457	16093
11.00 - 12.00	7360	8885	10406	11926	13446	14962
12.00 - 13.00	6751	8104	9449	10797	12140	13487
13.00 -14.00	4141	4970	5791	6615	7435	8255
14.00 - 15.00	4149	5015	5876	6734	7593	8452
15.00 - 16.00	4480	5409	6334	7255	8177	9100
16.00 - 17.00	5035	6078	7112	8149	9181	10213
17.00 - 18.00	4639	5627	6604	7587	8566	9544
18.00 - 19.00	4356	5224	6086	6949	7810	8672
19.00 - 20.00	4500	5422	6338	7258	8174	9090
Total	**70569**	**85102**	**99549**	**114015**	**128449**	**142880**

Table 5-3 A statement of progressive growth of traffic over 25 years

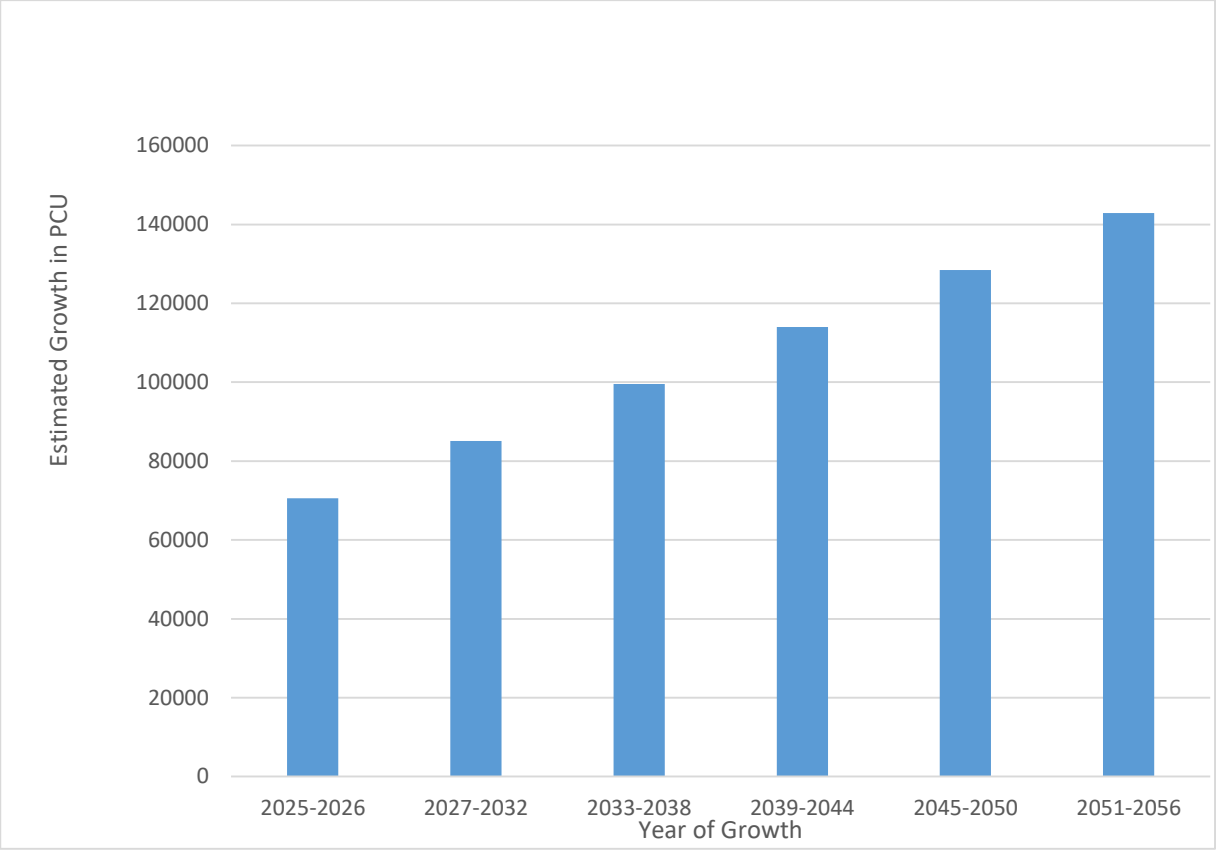


Figure 5-3 Graphical representation of Growth of Traffic for next 25 years

5.1.5 Peak Hour Growth of Traffic

Maximum peak hour traffic at the time of traffic survey conducted on 2021 is 70569 PCU/hr. Peak hour traffic growth at 5-year intervals has been estimated for 25 years and is tabulated in below Table 5-4 below.

Year	Estimated Growth (PCU)
2025-2026	70569
2027-2032	85102
2033-2038	99549
2039-2044	114015
2045-2050	128449
2051-2056	142880

Table 5-4 Peak hour Traffic/ Hour forecast for 25 years

5.1.6 Traffic Capacity of Project Road

The peak hour traffic / hour as estimated at this project road for the present year of count is 70569 to next 25 years will be 142880.

As per IRC-106 1990 “Guidelines for Capacity of Urban Roads in Plain Areas” the recommended design service volumes PCU/Hour for 6 lane divided two-way traffic is 4300 for sub-arterial road (with frontage access but no standing vehicles and high capacity intersections), and whereas for 4 lane divided two-way traffic is 2900.

As per IRC guide lines/recommendations, carriageways at grade level should be designed for more than 6 lanes with divider for two way traffic to accommodate 9544 V/H traffic in next 5 years in the project road. This leads to be land acquisition problem throughout the length of project and acquiring the land in urban area like Bengaluru is very costly and entire length of project is built up area and at some length with defense land.

As the PCU/hr at present year is 70569, at least 50% of the long run traffic will use elevated structure to reach their destination in short time by avoiding hurdles of junctions at grade road. Other benefits of constructing a high-rise structure on the project road include connecting different parts of the city and reducing traffic congestion. Several elevated corridors are planned to address the city's traffic problems, and this particular stretch is part of that plan.

Bengaluru is experiencing rapid urbanization and a corresponding increase in vehicle traffic, leading to severe congestion on major roads like Chord Road and the route through NICE Road. Existing roads are often narrow and heavily developed, making widening at the existing level difficult and leading to land acquisition issues.

When a four-lane elevated structure is constructed, most of the long-haul traffic is towards Mysuru diverted to the elevated structure to NICE Road and this leads to the relief of traffic congestion on the grade road. There will be an 8-lane carriageway along the entire length, where an additional 4-lane elevated structure can be constructed on the existing 4-lane road without land acquisition except at certain locations, if required.

After discussion with BSMILE officials and keeping in mind the concept of minimum land acquisition, a four lane divided Elevated corridor with carriageway of total width of 20.2 m has been proposed with two lane of 3.5 m each, 0.5 m median and 0.5 m crash barrier on either sides.

Therefore, the project is justified for the proposal of improvement of project with Elevated corridor with four lane carriageway.

5.1.7 Traffic Study for Toll Assessment

A comprehensive traffic study has been conducted for the Sirsi Circle- Nayandhalli corridor, and the study analyzed vehicle counts, diversion patterns, and willingness-to-pay percentages across all categories of traffic.

From this analysis, it is revealed that the toll able traffic volume on this corridor alone is not sufficient to justify toll collection. The corridor lies within a busy city area of Bengaluru, where traffic is highly mixed and fragmented between elevated structures, down ramps, at-grade roads, and existing flyovers. While diversion rates and toll willingness were assessed, the resulting toll able traffic count remains modest and does not support the establishment of toll plazas exclusively for this stretch.

In view of these findings, the toll traffic count has not been considered for toll operations. The project is therefore proposed to be implemented under the EPC Mode of contract, ensuring that the infrastructure is delivered efficiently and made available for public usage without the burden of toll collection. This approach balances financial responsibility with public convenience, allowing the corridor to serve as a free-flowing urban mobility improvement for Bengaluru.

6 Design Drawings

The initial design for the proposed concept of elevated corridor is prepared and design drawings also prepared accordingly. These drawings are prepared to provide guidance for detailed design and to prepare detailed cost estimates.

Engineering, procurement and construction (EPC) contracts (a type of turnkey contract) are called for tender, based on this concept of the project. This type of contract is a form of contract for undertaking construction works by the private sector in large-scale and complex infrastructure projects. An EPC contractor will coordinate all detailed design; Ensure procurement and construction work and entire project is completed as required and on time.

The following list of design drawings shown in table below are prepared and submitted as a part of project report as Volume - II.

Sl. No.	Title	Drawing No	Remarks
1	Location Map	SSP/DWG/PRJ/2025-26/19	Tender Purpose
2	Survey of India Map showing the project road	SSP/DWG/PRJ/2025-26/19-1	Tender Purpose
3	Google Earth Image showing the project road	SSP/DWG/PRJ/2025-26/19-1-1	Tender Purpose
4	RMP-2015 map showing the project alignment	SSP/DWG/PRJ/2025-26/19-2	Tender Purpose
5	Map showing District, Taluk, Hobali and revenue villages falling in the project road	SSP/DWG/PRJ/2025-26/19-3	Tender Purpose
6	Project Jurisdiction Map for the project road	SSP/DWG/PRJ/2025-26/19-4	Tender Purpose
7	Existing Traffic Flow pattern	SSP/DWG/PRJ/2025-26/19-5	Tender Purpose
8	Topographical Survey Drawing	SSP/DWG/PRJ/2025-26/19-6 (from Sheet No.1 to 7)	Tender Purpose
9	Concept and Alignment Plan	SSP/DWG/PRJ/2025-26/19-7 (from Sheet No.1 to 7)	Tender Purpose
10	Land Acquisition Plan and Schedule	SSP/DWG/PRJ/2025-26/19-8 (from Sheet No.1 to 5)	Tender Purpose
11	Plan and Profile	SSP/DWG/PRJ/2025-26/19-9 (from Sheet No.1 to 4)	Tender Purpose
12	Cross Sections	SSP/DWG/PRJ/2025-26/19-10-1 to 8 (from Sheet No.1 to 12)	Tender Purpose

Table 6-1 List of Drawings

7 Project Cost

7.1 Bill of Quantities

Total item wise quantities for Elevated corridor proposal for the project road are calculated as per the detailed drawings. Separate heads for all different items of work is included in the BOQ. The separate heads considered are detailed below: Civil Works, GST, Provisional cost, and Total project cost.

7.1.1 Civil Works

The project cost under civil works includes everything related to implementation of civil works including improvements of at grade roads, flyover / bridges, street lighting electrical works, and environmental works of plantation of trees, rain water harvesting works. Following are the subhead estimates under civil works.

7.1.1.1 Road works

Bill-1 Pre- construction Activities, Site Clearance & Dismantling

The quantity has been worked out for, dismantling of existing median/ white toping /flexible pavement, tree cutting and side drains for foundation works. The dismantling works are worked out based on the Proposed Typical cross sections.

Bill-2 Foundation (Pile &Pile cap):

The quantification of the Bored cast-in-situ piles including pile cap etc., are based on the measurement as per IRC standards shown in the typical cross sections. All the items which are related to completion of foundation up to Pile cap is considered in the estimate.

Bill No - 3 Sub Structures (Pier & PSC Pier cap)

The quantities related to substructure items pier, PSC precast pier cap including Pedestals, bearing, diaphragm, HYSD steel requirement, etc., are measured based on the typical cross sections in linear measurements.

Bill- 4 Super Structures (UHPFRC - U Girder)

The quantities of UHPFRC U girder, I Girder using as beam for portal frame, deck slab, etc., calculation for sub base has been worked out based on detailed LB&D dimension as per drawings.

Bill - 5 Reinforced Earth Approach Ramps to super structures (RE Wall)

The quantification of Fascia of RE Panel, earthwork, geo reinforcement, friction slab etc., are considered based on the typical cross sections. The quantity calculation for these items has been worked out based on detailed LB&D dimension as per drawings.

Bill- 6 Wearing Coarse for super structures

Stone Matrix Asphalt SMA with 3mm APP Polymer modified bituminous membrane is proposed the quantification of wearing course of Stone Matrix Asphalt is based on the typical cross sections showing the thickness and width of pavement layers.

Bill-7 Miscellaneous, finishing items for super structures (Crash Barrier, Painting, Handrail etc.)

Quantity of Crash barrier, Drainage spout, down take pipe, external painting, Hand rail on crash barrier, pavement marking and road appurtenances etc., are estimated based on the standard design of IRC and quantification is based on road drawings and alignment plan.

Bill No - 8 Streetlight over flyover

The detailed quantity estimates for different components of street light over elevated corridor and its approaches has been worked out based on detailed LB&D dimension as per drawings.

Bill No -9 Noise Barrier for controlling noise on flyover

A separate quantity estimate has been worked out under this bill for Noise barrier components. The estimate is based on location of sound pollution.

Bill No - 10 Restoration of existing road after completion of flyover construction,

The quantity for restoration of road into original condition is assessed and is included in the estimate. The restoration items like, resurfacing of flexible pavement with sub base to wearing coat, for thin white topping dry lean concrete with Thin white topping items are included Apart from the above, delisting relaying of kerb, footpath tiles etc., are also considered in the estimate.

Bill No - 11 Rainwater Harvesting

Estimate also includes the provision for construction of Rain water harvesting of 4 in numbers at the locations as identified by the client. This includes brick work, aggregates size ranging from 1.5mm to boulder type as per IRC Standards.

Bill – 12 Design charges @ 0.5% on total of above items 2 to 9 as per SR V-1 Sl. No. 1 Page 117 as it is EPC contract.

Estimate also have provision of design charges as this contract is going to be call under EPC / HAM contract.

Bill – 13 Maintenance charges

As per MORT&H standard, for stand-alone projects like Bridge / Tunnel / flyover works: maintenance charges are calculated. The contractor shall be paid @ 0.25% of the Contract Price each for the first five years and @ 0.50% of the Contract Price each for the remaining period of five years. on total of items as

per MORTH Letter. No.RW/NH-37010/4/2010-EAP(Printing) Vol.-IV Government of India Ministry of Road Transport & Highways Dated: 05.03.2019 AT Model agreement page 76 under section 14.1

7.1.2 The Project Amount Called in the Tender

The total amount estimated under the above bills from Bill-1 to 13 is the amount of civil works indicated as tender amount based on the current schedule of rate in the EOT proposal.

7.1.3 Goods & Service Tax (GST)

As per the latest GST rules the GST rate on works contract is 18% as per which the total amount is estimated to be kept as a provisional sum to be paid to the contractor at the time of passing the running bills.

7.1.4 Provisional Sum

As contingency expenditure, a provisional sum is reserved on the basis of percentage of civil construction cost to meet the following objectives.

Sl. No.	Description
1	Provision for Contingencies and Provision for Departmental Establishment Charges @ 2% on APT
2	Provision for Independent Engineer / PMC/DPR @ 1.50% on APT
3	Provision for Price escalation @ 2.5% for the 2nd year i.e., 2.5% on APT
4	Provision for utility shifting @ 8% on APT
5	Provision for Arboriculture/ Afforestation @ 0.50% on APT
6	Land Acquisition Cost including Structures
7	Miscellaneous and other Department Deposits

7.2 Rate Analysis

The unit rates have been arrived by considering the basic rates, lead distances, man power, machinery, and materials. The unit rate for every individual item will be arrived based on State PWD&IWTD Schedule of Rates, Bangalore Circle, for the year 2024-2025. Issue rates published by PWD were considered at the time of preparation estimate, i.e. 08-10-2025 & 06-01-2026.

An additional percentage for shuttering works as specified in the SR has been considered in the unit rate of the particular concrete items, according to which the total unit rates have been assessed.

Project area of construction of Elevated corridor shall be executed in the GBA limits, according to PWD SR 2024-25; the weightages of 10 percentages is added for finished items of BOQ in rate analysis.

PWD SR for Electrical works 2024-25 is used for estimating the Street light works.

BWSSB SR 2024-25 and Common Schedule of Rates is used.

Indian Railway Unified Standard Schedule of Rates 2019 is used to estimate the cost of transportation of UHPFRC Girders /Pre cast pier cap from casting yard to project site for innovative structure of elevated corridor. This SR is also used to derive the data rate.

The Items which are not available in any of state SR, the rate analysis for such items are derived from the available SR items and are shown in rate analysis estimate sheets enclosed at the end of this chapter.

7.3 Estimated Costs

Costs summary of the proposed Elevated Corridor project is presented in the following the total estimated Project cost is Rs. 810.00 Cr. Detailed item-wise estimated bill of quantities and rate analysis is enclosed in this report.

Sl. No.	Description	Amount in Rs	Percentage of Components
1	Pre - construction Activities, Site Clearance & Dismantling	34450072.32	0.64
2	Foundation (Pile &Pile cap)	1473511317.00	27.37
3	Sub Structures (Pier & PSC Pier cap)	353147536.00	6.56
4	Super Structures (UHPFRC - U Girder)	2852639169.00	53.00
5	Reinforced Earth Approach ramps to super structures (RE Wall)	45079536.00	0.84
6	Wearing Coarse for super structures (SMA)	49388804.00	0.92
7	Finishing items for super structures (Crash barier, painting, Handrail etc)	89844993.00	1.67
8	Streetlight over flyover	24282294.48	0.45
9	Noice Barrier for controling noice on flyover	34054692.10	0.63
10	Reconctruction of White topping road at Approaches including all allied works	133069122.25	2.47
11	Restoration of existing road after completion of flyover construction and + Rainwater Harvesting	31468224.51	0.58

Sl. No.	Description	Amount in Rs	Percentage of Components
12	Re construction of Compoundwall at LA Location for Govt and private properties.	19137104.48	0.36
13	**Credit for Dismantled Material:** Deduct Salvage values from Dismantaled structures like SSM masonary (scarp material Steel 151.55 MT(from Existing ROB structures, RE Wall) RE earth from Dismantaled Existing RE wall structures 60% of existing earth is considered for reuse during new RE wall structures.	-119976.69	
14	Design charges @ 0.5% on total of above items 2 to 12	51400728.65	0.95
15	Maintenance charges for stand-alone projects like Bridge/ Tunnel /flyover works: the contractor shall be paid @ 0.25% of the Contract Price each for the first five years and @ 0.50% of the Contract Price each for the remaining period of five years. on total of items as per MORTH Ltr No.RW/NH-37010/4/2010-EAP(Printing) Vol - IV Government of India Ministry of Road Transport & Highways Dated: 05.03.2019 AT Model agreement page 76 under section 14.1 d	191452675.38	3.56
16	**Amount Put to Tender (Civil Construction Cost)**	**5382806292.49**	**100.00**
17	**GST @ 18% on Amount Put to Tender**	**968905132.65**	
18	**Total Civil Construction Cost (APT+GST)**	**6351711425.14**	
19	Provision for Contingencies and Provision for Departmental Establishment Charges @ 1% on Amount Put to Tender (APT)	53828062.92	
20	Provision for Independent Engineer / PMC/DPR @ 1.50% on Amount Put to Tender (APT)	80742094.39	
21	Provision for Price escalation @ 5% , for the 2nd year i.e., 2.5% on Amount Put to Tender (APT)	134570157.31	2717193707.37
22	Provision for utility shifting @ 8% on Amount Put to Tender (APT)	430624503.40	
23	Provision for Arboriculture/ Afforestation @ 0.50% on Amount Put to Tender (APT)	26914031.46	
24	Land Acquisition Cost including Structures	1016923963.00	
25	Miscellaneous and other Department Deposits	4685762.24	
26	**Total Project Cost**	**8100000000.00**	

Sl. No.	Description	Amount in Rs	Percentage of Components
Estimated cost for Area and Km			
Cost / Sqmt (Structurer Area 76561.40sqmt) for structure (considering Foundation + sub + super structure + RE Wall approaches + Finishing + Lighting + Wearing course) = Rs.64,288/sqmt		**On Amount Put to Tender**	**On Total Project Cost**
Cost/Sqmt including all items from Sl. No. 1 to 15 & Cost/Sqmt including all items from Sl. No. iii to x		**74600.00**	**112257.00**
Cost/Km Viaduct length 6.181 + Approach 0.565km Total Length (including single lane loops + four lane + single lane approaches) = 6.746km (equal to four lane Carriage Way is 4 .0Km)		**797924295.00**	**1200711533.00**

Table 7-1 Project Cost Estimate

7.4 Compensatory afforestation

According to the NGT and the Ministry of Environment, it is proposed to plant the trees at a ratio of 1:10, i.e. planting ten trees against losing one tree.

In this project, about 45 trees are coming under construction width of corridor, most of the tress its branches are affecting, however it is planned to plant around 450 fresh plantations wherever possible in and around Bengaluru city area. Amount towards plantation is estimated in the detailed cost.

7.5 Re-usage of released materials

Various items of materials dismantled from existing RCC flyover, drain, footpaths, curbs and covered drains, etc., are proposed for to maintain a proper account and are proposed for recycled or auctioned based on quality of the items observed. The amount of material.

BSMILE have been requested to put a following specific condition in the Tender document for re-usage materials from dismantled items that,

1. All salvage materials as listed in the following Schedule of Credit shall become the property of contractor (when the work is awarded on tender basis) and salvage is already affected as deduction in the total project cost.
2. The materials enumerated below shall become the property of the contractor. These materials shall be allowed to be removed from site as the salvage value is already adjusted in the project cost.
3. The rate fixed by department is firm. The contractor shall have no claim whatsoever against the department if actual rate turns out to be different from the rates inserted by the department.
4. The amount of credit in respect of items shown below shall be provisional and actual quantities shall be measured in MB against each item shall be considered for arriving total amount of credit.
5. Items if any obtained from demolition/dismantling but not listed below shall become the property of government and accordingly shall be handed over to BSMILE without any extra payment.

Assessment of Salvage value for Dismantled materials

Sl No /Item No	Items	Unit	Quantity in BOQ Nos	Quantity of Re usage materials Can segregated/Unit	Current Material Rate as per SOR 24-25 Material/Market rate	Salvage rate considered/Unit	Amount(Rs)	Remarks
1	2	3	4	5	6	7	8=5x7	9
3 to 5 in preconstructi on Bill	Cutting of trees	MT	4	20	5000	2500	50000	Quantity of wood from felled trees can be expected as average 5MT per tree
9	Telephone/Na me board/signal post/Electrical poles	Nos	-	-	-	-	-	All Electri poles are very old and entilre poles to be handed over to BBMP/BESC OM Electrical maintanance department.
2	Dismanteling of concrete	Cu m	3705	370	640.12/cum	100/cum	37047	aggregates on 10% of dismanteled qnty can be re used, about 15% of dismanteled SR rate is considered for salvage vaue
	Hysd steel	Cu m	55.6	Hysed steel 15kg/cum=82 00kg (8.2MT) for 547.2 cum	Rs79011/ton ne as per CSR V-1 2.11h	Rs39505/t onne (50% of SR Issue rate is considere d)	32930	Scrape material =8.2x39505
Total Salvage							1,19,977	

Table 7-2 Schedule of Credit for Dismantled materials

7.6 Structural Area Statement

Length Details of Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road (5.22 Km)							
Sl No	**Description**	**Chainage**	**Viaduct length**	**Approach length**	**Total Length**	**Width of Viaduct**	**Area of Viaduct**
1	Taking Loop from sirsicircle flyover on RHS traffic from KR Market is extended and connectedat Gopalan mall kudure flyover	Ch 0 to 0+968	968	Nil	968	8.5	8228
2	Taking Loop from new flyoveron LHS traffic from Mysuru is extended and connected at Existing flyover at ch 0	Ch 0 to 0+968	968	Nil	968	8.5	8228
3	Proposed 2 Lane (7m Width) Flyover FROM Gopalan Mall (LHS) to Sirsicircle	Ch 430 to 968	473	65	538	7	3311
4	Proposed 2 Lane (8.5m Width) Flyover approach from Kudhure Park to Gopalan Mall (RHS)	Ch 0+695 to 0+895	100	100	200	8.5	850
5	Proposed 4 Lane (20.2m Width) Flyover from Gopalan Mall to BHEL Junction near Vrishabhavati River Bridge	Ch 968 to 2+790	1822.00	Nil	1822.00	20.2	36804.4
6	Proposed Single Lane (7 m Width) Down Ramp near Bytarayanapura Police Station to BHEL Junction near Vrishabhavati River Bridge	Taper from Ch 2405 to Rewall 2755	250	100	350	7	1750

Length Details of Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road (5.22 Km)							
Sl No	**Description**	**Chainage**	**Viaduct length**	**Approach length**	**Total Length**	**Width of Viaduct**	**Area of Viaduct**
7	Proposed 2 Lane (8.5m Width) Flyover BHEL Junction near Vrishabhavati River Bridge to Existing Nayandahalli Flyover (Indian Oil Petrol Bunk)	Ch 2+790 to 3+450RHS	560	100	660	8.5	4760
8	Proposed 2 Lane (8.5m Width) Up Ramp from K.S.R.T.C Bus Depot No. 5 to BHEL Junction near Vrishabhavati River Bridge	Ch0+000 to 0+332 (at Ch 2550)	170	100	270	8.5	1445
9	Proposed 2 Lane (8.5m Width) Loop from Vijayanagara to Proposed Flyover near Sri Gali Anjaneya Swami Temple Junction including taper merging towards KR Market	Ch0+000 to 0+310 (pier for 135m length+for 175m portal frame)+Taper length 150m merging	460	Nil	460	8.5	3910
10	Proposed single lane (7m) Flyover from Rotary at BHEL Junction to NICE Road	Ch 0 to 0+350	410	100	510	7	2870
11	Length of flyover of WITH Viaduct & Approach	-	**6181.00**	**565**	-	-	-
12	Total length of Flyover including Viaduct and RE Wall approaches & Viaduct deck area	**6746.0m**					
13	Total area of Viaduct	**72156.40 Sqm**					
14	Total Area of Approach	**4405.0 Sqm**					
15	Total area including viaduct and approaches	**76561.40 Sqm**					

7.7 Justification for Project Cost

NHAI data (Normative Cost) for cost-estimates of National Highways is updated by the Ministry of Road Transport and Highways from time to time and a standard cost per square meter for roads and structures has been arrived at based on various assumptions.

The standard costs obtained on the basis of NHAI circular dated 25/04/2018 are being used only for comparison during appraisal and approval of projects.

The standard cost of an elevated flyover with high strength concrete prepared by MORT&H is as follows and is compared with BSMILE elevated projects proposed for construction with UHPFRC superstructure elements.

Although the table below indicates that the initial cost of structures using UHPFRC is higher than the standard construction cost, the following facts demonstrate that the use of UHPFRC remains economical and justified when compared to conventional methods.

Statement showing the MORT&H Normative cost with Escalation @ 5% from 2018 to 2025						
Normative Cost during the Year 2018 for Plain Terrain Rs. in Cr						
Comparison of Bridge cost	Description of Work	Bridge Proper Cost	Bridge Proper Total Cost	Approach	Total Cost (Bridge + Approach)	Bridge Proper Cost (Per Sqmt)
MORT&H	**Elevated structure like Flyovers 4 lane carriageways**	**0.003**	**2.98**	**12.15**	**15.13**	**0.004**

Normative Cost with price escalation @ 5% from 2018 to 2025 year for Plain Terrain Rs in Crore							
Bridge Proper Cost (Per sqmt) FOR 2018 YEAR	Bridge Proper Cost (Per Sqmt) @ 5% for2019 Year	Bridge Proper Cost (Per Sqmt) @ 5% for2020 Year	Bridge Proper Cost (Per Sqmt) @ 5% for2021 Year	Bridge Proper Cost (Per Sqmt) @ 5% for2022Year	Bridge Proper Cost (Per Sqmt) @ 5% for2023 Year	Bridge Proper Cost (Per Sqmt) @ 5% for2024 Year	**Bridge Proper Cost (Per Sqmt) @ 5% for2025 Year**
0.004	0.0042	0.00441	0.004631	0.004862	0.005105	0.00536	**0.005628**

The National Highways Authority of India has prepared a DPR in the year 2022 for the project of construction of Flyover from Indora Chowk to Dighori Chowk in Nagpur city on NH 353D on EPC Mode in the State of Maharashtra. The flyover cost as per the DPR estimate is shown in the Table below with escalation price as on 01-09-2025.

Statement showing the Nagpur DPR cost with Escalation @ 5% from 2022 to 2025						
Flyover structure Cost during the Year 2022 for Plain Terrain Rs in Cr						
Comparison of Bridge cost	Description of Work	Foundation, substructure Super structure	Super structure	Fixed cost	Total Cost)	Bridge Proper Cost (Per Sqmt)
NHAI	**Nagpur project work (**Indora Chowk to Dighori Chowk) **as described above**	**90.84**	**277.2**	**24.68**	**392.72**	**0.0045**

Normative Cost with price escalation @ 5% from 2018 to 2025 year for Plain Terrain Rs in Crore			
Bridge Proper Cost (Per sqmt) FOR 2022 YEAR	Bridge Proper Cost (Per Sqmt) @ 5% for2023Year	Bridge Proper Cost (Per Sqmt) @ 5% for2024Year	Bridge Proper Cost (Per Sqmt) @ 5% for2025Year
0.0045	0.00472	0.00496	0.00520

Statement showing the proposed Elevated flyover project from Sirsi Circle to Nayandahalli on Mysuru Road for the year 2025						
Flyover structure Cost during the Year 2022 for Plain Terrain Rs. in Cr						
Comparison of Bridge cost	Description of Work	Foundation, substructure	Super structure	Fixed cost	Total Cost)	Bridge Proper Cost (Per Sqmt)
Project	**Sirsi circle to Nayandhalli**	**182.66**	**302.69**	**21.13**	**506.48**	**0.0070**

Comparison of Flyover cost per square meter compare to Normative cost of MORT&H, NHAI Nagpur DPR Cost and Proposed Project cost is made comparison in the following Table.

Statement showing the Comparison cost of Flyover		
Flyover structure Cost during the Year 2025 for Plain Terrain Rs in Cr		
Comparison of Bridge cost	Description of Work	Bridge Proper Cost (Per Sqmt)
MORT&H	**Normative Cost**	**0.0056**
NHAI Project of Nagpur	**DPR Cost**	**0.0052**
Proposed Project	**DPR Cost**	**0.0070**

Elevated Corridor Project cost /sqmt on Amount put to Tender	
Amount put to Tender	**Rs. 5,38,28,06,292.49**
Structure Area (Viaduct and Approaches) in Sqmt	**76561.40 Sqmt**
Cost /Sqmt	**Rs. 64,288.00**
Normative Cost as per MORTH Updated with price escalation @5% from 2018 to 2025 year	**Rs. 56,280 .00**
Difference between Normative Cost/Sqmt with project details	**Rs. 8,008.00**

For arriving normative cost, the Committee's chaired by MORT&H senior officials had made a various assumption to calculate the Normative cost which are as follows:

Flyover for 4 lane carriageways

Sl No	Description of structure	Type of Structures components
1	Type of Foundation	Pile foundation with steel liner 15m depth
2	Type of Pier	Circular
3	Vertical Clearance	5.5m
4	Span arrangement	10m+20m+10m =(40m)
5	Super structure	Pre stressed Girder type
6	Width of Carriageway	As per IRC Manual

Comparison of normative cost of elevated flyover between High Strength Concrete of M-50 -60 with M-150 TO 200 UHPFRC Structures on Amount Put to Tender.

Sl. No	Description	As per Normative cost for conventional High strength Concrete	If the UHPFRC technology is adopted	Remarks
1	Span	10 x 2 + 20 x 1 =45m	Single span of 45 x 1	No intermediate pier support
2	Number of Pile/ Pile cap /Pier	16 piles, 4 Nos of Pile cap and Pier	8 Piles, 2 Numbers of Pile cap/Pier	50% of structure items are get reduced results in terms time period reduces.
3	PSC Girders	16 to 18 PSC Girders, with thick structures and heavy weight for 3 span	4 Girders for 40m span, light in weight	
4	Time of Construction	Minimum one year	Maximum 3 months	Saved in Cost over run
5	Normative cost per Square meter	Rs 56,280/sq mt		Which includes only Foundation/Substructure/Super structures wearing course approaches and excluding other costs of a. Pre-construction activities, design charges/Maintenance charges/Restoration of existing road with re construction/Noise barrier, Traffic sinages ETC.,
			Rs 74,600/Sqmt on Amount estimated for Tender	This amount includes every things which are excluded in the Normative cost as indicated above in remarks.

If the elevated corridor is executed using high-strength concrete of M-50 to M-60 grade, the estimated cost of structures works out to ₹96,377 per square meter, which is more than 29% higher than the standard cost per square meter.

By adopting UHPFRC concrete for girders in superstructures, savings of about 55% in piles, 33% in piers, and pier caps can be achieved, resulting in both cost and time efficiencies. For the 20.2 m wide carriageway, UHPFRC girders cover approximately 35% of the total corridor length (5.22 km), leading to considerable savings in overall project cost and construction time. While the cost per square meter is slightly higher compared to an 8.5 m wide carriageway with UHPFRC girders, the benefits in terms of reduced foundation requirements and faster execution outweigh the incremental increase.

If a conventional structure, as considered for normative costing by MoRTH, were constructed with UHPFRC in a single-span configuration, the cost per square meter would be assessed at approximately ₹25,000.

It is important to note that MoRTH normative rates are based on works in rural and district areas, and do not reflect the higher costs associated with urban projects in cities like Bengaluru. When the proposed project cost is compared with similar structures in MoRTH and NHAI DPRs, such as the Nagpur project, the justification for UHPFRC adoption becomes evident.

Furthermore, the use of UHPFRC ensures considerable time savings during construction, thereby reducing risks of cost overruns due to delays in large-scale high-strength concrete works. Many restoration and ancillary works, which are essential in urban contexts, are not accounted for in the standard normative cost.

Therefore, the incremental difference of ₹13,580 per square meter between the UHPFRC cost and the normative cost is fully justified, given the time savings, reduced foundation requirements, and long-term durability benefits of UHPFRC structures.

When compared with similar projects of the MoRTH and NHAI, such as the Nagpur DPR, the proposed project cost is justifiable. Table below justifies the initial cost per sqm of UHPFRC

Parameter	**MoRTH Benchmark**	**UHPFRC**	**Conventional M50 (30m span)**	**Remarks**
Cost per sqm	₹40,000	₹74,600	₹96,377	UHPFRC higher upfront, but significantly lower than conventional M50 for this corridor
Design Life	40–50 years	100 Years	40–50 years	UHPFRC doubles lifespan, reducing long-term replacement needs
Maintenance	High (rehabilitation every 10–15yrs)	Minimal	Moderate	UHPFRC reduces O&M costs due to superior durability
Span	30m	45m	30m	Longer span reduces number of piers, foundations, and land acquisition
Urban utility Impact	Moderate	High	High	Corridor complexity factored; UHPFRC minimizes disruption by reducing pier density
Lifecycle Cost	Highes	Lower	Highest	UHPFRC most economical over 100 years when lifecycle savings are considered

While the initial cost per sqm is higher, the total lifecycle cost is significantly lower, and the choice of UHPFRC is both technically and economically justified.

8 Environmental Impact Assessment Study

8.1 Back Ground

Bengaluru's vehicle population has been growing day by day and the city roads are being added roughly 5 lakh vehicles every year. Reently total vehicle population in Bengaluru is reached about 1.2 Crore, the number of non-transport vehicles such as two-wheelers and cars in the city had reached 1.06 Crore. According to State Transport Department, two-wheelers are numbering over 81.9 lakh followed by cars numbering 23.59 lakh. Number of transport vehicles stands at over 10.89 lakh. These numbers exclude the vehicles that come in and go out of the city. This out growing numbers vehicles are choking the city roads with frequent traffic jams and have made traffic police helpless.

Further, for various known reasons public is using the independent modes of transportation for commuting on existing limited road network adding to the congestion, accidents, noise and air pollution. As per the report on Comprehensive Traffic and Transportation Plan for Bangalore (CTTP) – 2011, an average Bangalore an spends more than 240 hours stuck in traffic every year and such delays are resulting in loss of productivity, in addition to deterioration of air quality, reduced quality of life, and increase in costs for services and goods.

The concept of elevated corridor evolved to counter the traffic woes of the city in the form of traffic congestion and provide solution for many of the traffic related problems. The project is envisaged to separate the cross-city traffic and the neighborhood traffic, with an aim to decongest the core city and provide easy access to suburban towns and Bengaluru International Airport. The project is planned based on two traffic directions of the city – North - South and East - West, with interconnecting and loop elevated corridors. The basic idea is to decongest at grade roads by creating an additional capacity in the form of elevated corridors. This enhances the traffic carrying capacity of the roads at grade. As the widening of Bengaluru city roads is not possible, we are only left with the option of going vertical by elevated corridors.

In this context, Government of Karnataka has planned for elevated corridors to ensure safe, fast and congestion free connectivity to different parts of city. The issues relating to traffic and transportation in a large and growing city like Bangalore need to be viewed in the larger perspective of urban planning and development. Issues relating to land use planning and development control, public-private transportation policy and industrial location would need to be integrated at the perspective planning level. With Metro Rail under implementation there is the need to coordinate inter modal transport issues.

8.2 Land Use and Roadside Environments

The observed land use pattern is predominantly residential layout formed by the Bangalore Development Authority, as the city grew, residential units along the main road were leased out to commercial activities and the road itself became predominantly commercial.

There are bus stops with shelters along the corridors, skywalks / foot over bridges, gantry sign boards, street lights like high mast lamps, etc. are also in place. The project corridors are surrounded by important community structures such as schools, colleges and places of religious importance such as temples, mosques and churches. The implementation of the project will not affect these structures and the compound wall may need to be relocated in some places to avoid the impact.

Traffic growth rates have been estimated based on the traffic flowing on the project road. The overall traffic growth rates for the next 25 years have been estimated considering the annual growth rate (%) of various vehicle types.

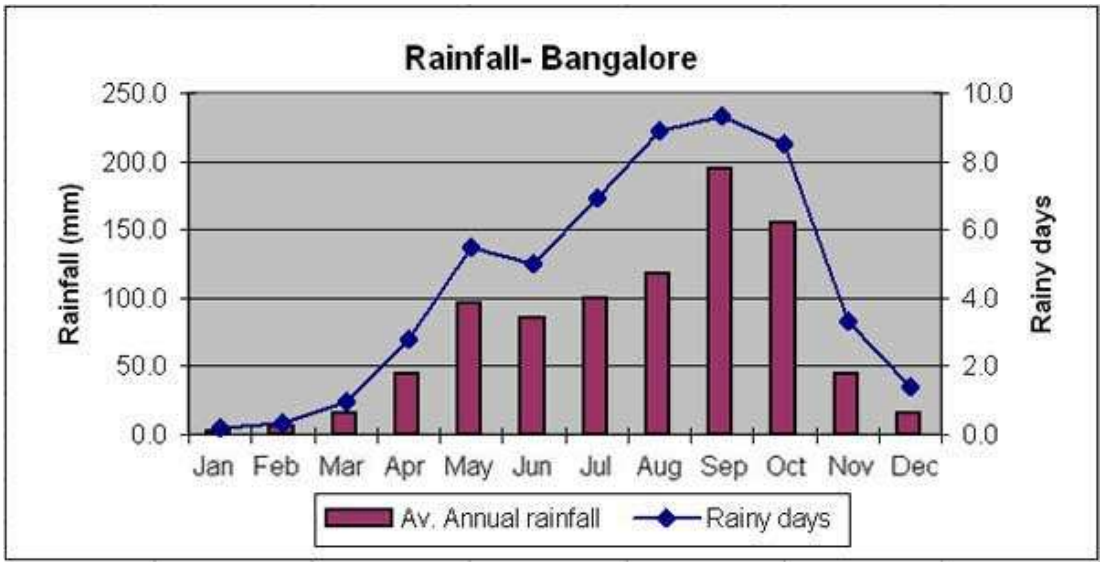
As per the traffic study the project corridor carries a traffic of 70569 vehicles / hour at peak time, whereas the maximum capacity of traffic that can be handle by project road at present for a road width of 30m with four lane is about 2800 vehicles/hour. There is now a need to widen the road to accommodate the next 5 to 25 years traffic growth of 85102 to 142880 vehicles per hour.

Since widening of the roads in Bengaluru city is not possible, we are left with the only option of going vertically through elevated corridors.

This elevated corridor aims to separate inter - city traffic and neighborhood traffic, reducing congestion in the major city and providing easy access to suburban and satellite towns, and the Bangalore International Airport. The basic idea is to reduce congestion on at-grade roads by creating additional capacity in the form of elevated corridors. This will increase the traffic capacity of at - grade roads.

8.2.1 Climate

Bengaluru has a tropical Savanna climate with distinct wet and dry seasons. January is the coolest month in Bangalore, with an average low temp of 15.1°C. April is the hottest, with an average high of 34.1°C. The highest temperature ever recorded in the city was 39.2°C on April 24, 2016. The lowest temperature ever recorded was 7.8°C in January 1884. In winter, usually the temp doesn't fall below 14°C, and in summer go above 36°C. The city gets rain from both the north east and southwest monsoons. The city gets a yearly rainfall of around 975 mm on average, with significant variations throughout the year. September typically receives the highest rainfall, followed by October and August. The period from June to October generally accounts for the majority of the annual rainfall. The graphical representation is shown in the figure below. The average speed of the wind is 3.4 m/s, with a maximum of around 11 m/s.



8.2.2 Humidity

The average annual relative humidity in Bengaluru is 65.2% and average monthly relative humidity ranges from 45% in March to 79% in August. On an average, July is the most humid and January is the least humid month.

8.2.3 Temperature

The highest temperature ever recorded in Bengaluru was 41.8°C in Kengeri on April 30, 2024. The lowest temperature recorded was 7.8°C in January 1884.

8.3 Legal Framework of Government of India

The Government of India has laid out various policy guidelines, acts and regulations pertaining to sustenance of environment. The Environment (Protection) Act, 1986 provides umbrella legislation for the protection of environment. As per this Act, the responsibility to administer the legislation has been jointly entrusted to the Central Ministry of Environment, Forests and Climate Change (MoEF & CC) and the Central Pollution Control Board (CPCB) / State Pollution Control Board (SPCB). The lists of most relevant Government of India regulations and applicability to this project are provided in the following sections.

8.3.1 Key Environmental Laws and Regulations

The lists of most relevant Government of India regulations are provided in the below table.

Act/Rules	Objective	Applicable Yes / No	Reason for applicability	Authority
The Environment (Protection) Act	To protect and improve overall environment	Yes	As all Environmental notifications, rules and schedules are issued under this act.	MoEF & CC. Go l; DoE, State Gov. CPCB, KPCB

Act/Rules	Objective	Applicable Yes / No	Reason for applicability	Authority
The Environmental Impact Assessment (EIA) Notification	To provide environmental clearance to new development activities following environmental impact assessment	No	This notification is not applicable to this Project roads, as they do not attract the conditions of obtaining prior environmental clearance as per the Notification.	MoEF & CCSEIAA
The Forest (Conservation) Act 1980	To check deforestation by restricting conversion of forested areas into non- forested areas	No	The project roads do not pass through forest land.	Forest Department, Government of Karnataka
MoEF & CC circular on linear Plantation on roadside, canals and railway lines modifying the applicability of provisions of forest (Conversation) Act, to linear Plantation 1998	Protection / planting roadside strip as avenue/strip plantations as these are declared protected forest areas.	No	Roadside tree plantation in Karnataka is primarily governed by the Karnataka Preservation of Trees Act, 1976, and not the Karnataka Forest Act.	MoEF & CC
The Water (Prevention and Control of Pollution) Act and Cess Act of 1977 as amended to date. 1974	To control water pollution by controlling emission & Water pollutants as per the prescribed standards	Yes	This act will be applicable during construction for (establishments of hot mix and concrete plant, construction camp, workers' camp, etc.	KSPCB
The Air (Prevention and Control of Pollution) Act as amended to date 1981	To control air pollution by controlling emission and air pollutants according to prescribed standards	Yes	This act will be applicable during construction; for obtaining NOC for establishment of hot mix and concrete plant, workers' camp, construction camp, etc.	KSPCB
The Noise Pollution (Regulation and Control) Rules 2000	Noise pollution regulation and controls	Yes	This act will be Applicable as vehicular noise on project routes required to assess for future years and necessary protection measure need to be considered in design.	SPCB

Act/Rules	Objective	Applicable Yes / No	Reason for applicability	Authority
The Biological Diversity Act 2002	To provide mechanism for equitable sharing of benefits arising out use of traditional biological resources and knowledge		Preserve Biological resources	
The Environment (Protection) Act	Eco sensitive Zone around NP/Sanctuary.	No	This is not applicable as no Wildlife sanctuary fall within 10km radius from project road sections	Chief Conservator Wildlife, Wildlife Wing, Forest Department, Govt. of Karnataka
The Ancient Monuments and Archaeological sites & Remains Act	Conservation of Cultural and Historical remains found in India	No	This act not applicable as the project routes are not close to any Ancient Monument, declared protected under the act.	Archaeological Dept. Gol, Indian Heritage Society and Indian National Trust for Art and Culture Heritage (INTACH).
Notification for use of fly ash	Promoting the utilization of fly ash in the manufacture of building materials and in construction activity within a specified radius of one hundred kilometers from coal or lignite based thermal power plants	No	There are no coal-Based thermal power plants located within a 100km radius of Bengaluru.	
The Explosives Act (& Rules)	An Act to regulate the manufacture, possession, use, sale, transport, import and export of Explosives	Yes	For transporting and storing diesel, bitumen etc.	KSPCB
The Public Liability Insurance Act	Protection form hazardous materials and accidents.	Yes	Contractor need to stock hazardous material like diesel, Bitumen, Emulsions etc.	KSPCB
The Coastal Regulation Zone	To regulate activities in the coastal zone to protect ecologically sensitive areas.	No	The project road is far away from coast line	SCZMA, MoEF & CC

Act/Rules	Objective	Applicable Yes / No	Reason for applicability	Authority
The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules	Storage, handling, transportation and disposal of hazardous waste	Yes	Storage and handling of hazardous waste during construction	KSPCB
The Municipal Solid Wastes (Management & Handling)Rules	Management and handling of solid waste	Yes	For disposal of solid waste generated during construction	KSPCB
The Batteries (Management & Handling) Rules as Amendment Rules	Management and handling of used lead batteries	Yes	Safe disposal of used lead batteries	KSPCB
The E-Waste (Management & Handling) Rules	Effective mechanism to regulate generation, collection, storage, transport, import, export, recycling, treatment and disposal of e-wastes.	Yes	Handling of e-Waste	KSPCB
The Central Motor Vehicles Act Karnataka Motor Vehicle Rules	To control Vehicular air and noise pollution.	Yes	This rule will be applicable to road users and construction machinery.	Motor Vehicle Department
The Minor Mineral and concession Rules	For opening new quarry.	Yes	Regulate use of minor minerals like stone, soil, river sand etc.	District Collector
The Mining Act	The mining act has been notified for safe and sound mining activity.	Yes	The construction of project road will require aggregates. These will be procured through mining from quarries	Department of mining, Govt. of Karnataka
The National Forest Policy 1952 National Forest Policy(Revised)	To maintain ecological stability through preservation and restoration of biological diversity.	NO	This policy will not be applicable as NO eco sensitive feature exists along the Project corridor.	Forest Department, and Govt. of Karnataka
The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act	Set out rules for fair compensation and acquisition of land	Yes	This act will be Applicable as there will be acquisition of land for widening, geometric improvements and realignments of elevated corridor.	Revenue Department State Government.

Table 8-1 Environmental Regulations of Government of India

9 Review of Detailed Project Report by Expert Committees

The Detailed Project Report (DPR) concludes with an overall summary of the project, along with recommendations and compliances relevant to its implementation.

9.1 Expert Committees Review

The DPR was reviewed by the following Technical committees, and their discussions, observations, and compliance notes are also detailed below:

1. GBA Technical Advisory Committee – 22.08.2025
2. Bengaluru Metro Rail Corporation Limited (BMRCL) – 13.11.2025
3. Directorate of Urban Land Transport (DULT) – 29.01.2026 to 06.02.2026
4. Traffic Police Commissioner Bengaluru
5. Bengaluru Electricity Supply Company (BESCOM)
6. Bengaluru Water Supply & Sewerage Board (BWSS&B)
7. State Level Environment Impact Assessment Authority- Karnataka
8. National Highways Authority of India Regional Office Bengaluru

9.1.1 Discussion at GBA Technical Advisory Committee Meeting

At the preliminary stage, the DPR proposed a four-lane elevated flyover with a rotary interchange at BHEL Junction. The corridor was planned from Sirsi Circle to Nayandahalli Junction, with up-ramps and down-ramps to facilitate traffic from K.R. Market Flyover, Chamarajpet, Sirsi Circle, Binny Mill Tank Bund Road, Nayandahalli, Vijayanagar, and Hosakerehalli (NICE Road).

The DPR, with an estimated cost of ₹765.00 crore, was placed before the BBMP Technical Committee on 22.08.2025. After reviewing the conceptual plan, the committee suggested modifications to integrate the proposed corridor with the Kumbalagodu Flyover, located about 12 km from BHEL Junction.

The Committee has opined to accept the DPR proposal, subject to incorporation of the comments and observations in the revised DPR, and to proceed with the tendering process without placing the matter before the Committee again.

Modification of DPR

Following the committee's recommendations, the DPR was revised in consultation with officials of the BSMILE office. Key modifications included:

- An elevated rotary at BHEL Junction to make the junction signal-free, facilitating traffic from NICE Road and Nayandahalli, while integrating flows from K.R. Market.
- Connectivity to the Kumbalagodu Flyover near Sri Panchamukhi Ganesha Temple via the NICE Corridor.

- Revised ramp arrangements to streamline traffic movement between Sirsi Circle, Nayandahalli, Vijayanagar and Hosakerehalli.

With these modifications, the project cost was revised to ₹810.00 crore.

9.1.2 Review by various Organisations of Government

The Director (Technical), BSMILE, has formally communicated through official letters to various Government organisations, as listed above section 9.1, to inform them about the major project of a 126.31 km Elevated Corridor currently under planning and approval for implementation. Copies of these letters addressed to the respective departments are annexed in this project report.

In addition, the technical heads of these organisations were invited to the BSMILE office, where a detailed presentation on the proposed 126 km Elevated Corridor in Bengaluru was delivered. The purpose of this presentation was to alert the departments and ensure coordination in project implementation, particularly to integrate any ongoing or proposed schemes that may overlap with the corridor alignment. This proactive step was taken to avoid complications and delays in resolving conflicts at a later stage.

All departmental officers attended the presentation, sought clarifications, and assured BSMILE that any major planning initiatives within their respective departments would be discussed and clarified in advance. Public service agencies such as BESCOM and BWSSB were specifically alerted regarding their utility services existing along the proposed corridor routes.

Furthermore, the BSMILE office has sought information from the Karnataka State Pollution Control Board (KSPCB) regarding clarifications on environmental clearance required for the implementation of the Elevated Corridor project.

The Project Director of the NHAI Bengaluru Regional Office also presented and reviewed matters related to the integration of flyovers with the NHAI Corridor, ensuring coordination between the two organisations.

9.1.3 Discussion with Bengaluru Metro Rail Corporation Limited (BMRCL)

The Director (Technical), BSMILE, requested the Managing Director of BMRCL to review the DPR prepared by the Consultants for this project and to provide their recommendations, comments, and suggestions through office letter No. B-Smile/ni (tham)/PR/329/2025-26 dated 13/10/2025.

In response, BMRCL invited BSMILE officers for a detailed technical discussion on 13/11/2025 at their office, 2nd Floor, BMTC B-Block, K.H. Road, at Shanthinagara Bengaluru. The meeting was attended by the Director (Technical), Chief Engineer, and other officers of BSMILE along with the Consultants. The session was chaired by Shri Hegga Reddy, Chief Engineer, BMRCL, along with their Technical team.

A presentation was made to BMRCL covering the project corridor alignment and key Technical aspects of planning and construction methodology. The alignment at BHEL Junction, where the proposed flyover intersects or runs parallel to the Metro corridor, was reviewed in detail.

BMRCL agreed in principle to the concept of the alignment passing through and running parallel to the Metro corridor, subject to confirmation of adequate vertical / horizontal clearance for the flyover.

Overall, BMRCL conveyed their concurrence with the DPR, noting no major observations.

9.1.4 Review of Detailed Project Report by DULT

The Detailed Project Report (DPR) prepared by the BSMILE office was submitted to the Directorate of Urban Land Transport (DULT) for review. Observations on the proposal were received from DULT on 29.01.2026, as detailed below.

Observations of DULT on the proposal for construction of Elevated Roads

Sl. No	Proposed Elevated Roads	Observations of Dult
1	Mysuru Road from Sirsi Circle to Nayandahalli (6.02 Km)	The proposed corridor aligns with the proposed elevated corridors in approved CMP Bengaluru 2020 (Refer Fig 4-10 Elevated Road corridors in the CMP).
2		The accurate positions of piers to be provided in the proposed topography plan along with cross sections at the pier locations. Also provide details of carriageway, median, footpath, drain at grade level to identify the locations with space constraints for traffic movement, since Mysuru road witnesses large share of buses and pedestrian movement.
3		A weaving length of only 65m has been proposed in the DPR between the up ramp of the existing BGS flyover and the down ramp of proposed 2-laneunidirectional flyover. As per IRC 92- 2017 “Guidelines for the design of interchanges in urban areas (Ref. fig 7.1), even assuming a conservative speed of 30 kmph and 1000 PCU/lane/hr, a minimum weaving length of 500m must be provided. This weaving length will provide opportunity for merging and diverging of vehicles without significantly reducing traffic speeds. Lowering the weaving length will lead to bottleneck as motorist will need to slowdown to find gaps to change lanes and will lead to shock waves in the traffic stream. Therefore, the proposed weaving length of 65m is grossly inadequate for safe merging/diverging of traffic and will become a major bottleneck point and can potentially become a black spot (high accident location) as well. Hence, it recommended to adhere to standards and possibly analyse the operations at these stretches through traffic simulations to determine the appropriate weaving lengths and additional safety measures to be implemented and modify the design/DPR accordingly. Similarly, the weaving length available between ramp of proposed elevated corridor and ramp up of existing flyover at Nayandahalli must be checked and appropriately addressed as recommended above.

Sl. No	Proposed Elevated Roads	Observations of Dult
4	Mysuru Road from Sirsi Circle to Nayandahalli (6.02 Km)	An elevated rotary has been proposed in the DPR to accommodate traffic entering/exiting from NICE road. However, the weaving length provided for traffic streams from outbound on Mysuru Road and that entering from NICE road ramp is very less, similarly weaving length provided for traffic stream inbound on Mysuru Road and diverging to Nice Road ramp seems inadequate. However, as per IRC 65: 1976 (Recommended Practice for Traffic Rotaries) weaving length for rotaries must be atleast 4 times the weaving width. • Elevated rotary has 4 lanes (i.e 4*3.75m =15m) • Minimum weaving length required to be provided for safe merging/diverging to take place is 60m (4 * 15m). If adequate weaving length is not provided, it could replicate the similar congestion scenario as in the case of existing Hebbal flyover (inadequate weaving length for traffic merging from ORR causing traffic pileup on Hebbal), which is detrimental to the purpose of providing a elevated road.
5		At the intersection of Vrishabhavathi river and Mysuru road, the carriageway narrows down. Due to introduction of columns of proposed elevated corridor and ramps, this stretch (at-grade) will get even more narrow for the traffic movement. This could become a choke point as the stretch of road already faces severe congestion during peak hours and condition could if further space is taken for elevated road columns. Hence a thorough traffic simulation study is recommended to be carried out to understand the impact on at-grade traffic movement before the alignment and column locations are finalized for least impact scenario.
6		At the section where the ramp of elevated corridor is passing underneath the purple line metro track • Minimum vertical clearance of 5.5m required) between at grade level and ramp of elevated corridor • Minimum vertical clearance (min 5.5m required) between elevated corridor and under-surface of purple line metro track Considering the deck thickness of the elevated road and safety margin, atleast 12-13m clearance should available between current ground level and metro viaduct. This may kindly be verified.
7		Additionally, at BHEL junction witnesses traffic congestion regularly. Introduction of additional piers due to proposed elevated corridor might worsen the traffic situation.
8		The proposed designs do not indicate any wayside stopping provision or shoulder space on the elevated road for emergency management (like vehicle breakdowns, emergency stoppage etc.). Provision for the same must be made at frequent intervals in both directions.
9		The project proposal assumes that 50% of the current traffic will use the proposed elevated corridor, a clear justification must be provided for such an assumption as it is given to understand that the development of the elevated roads may happen on PPP basis and may be tolled. When tolls are introduced, the usage generally reduces as compared to road free for use.

Sl. No	Proposed Elevated Roads	Observations of Dult
10	Mysuru Road from Sirsi Circle to Nayandahalli (6.02 Km)	Since the proposed elevated corridor spans across 6.02 km, there will be spatial variation in the traffic volume along the corridor. But the DPR mentions of traffic analysis being carried out only at a single point. Therefore, the traffic analysis must be carried out at multiple major junctions to capture traffic volume variation along the corridor. Such assessment should be utilized to estimate the traffic demand, section wise on both the elevated section and at-grade section.
11		The DPR provides a very basic alignment, plan and a typical cross-section for the elevated corridor. However, due to the placement of columns, ramps for the elevated corridor, there would be alterations to the at-grade road, which may have adverse impact on traffic movement at-grade. The DPR does not provide any information on the following: • Exact footprint of the columns and ramps of the elevated structure on ground • Proposed plan for at-grade road, indicating space provisioned for travel lanes, median, footpath, bus stops, bus bays, auto rickshaw stands, parking bays (where required), utilities etc. • Proposed plan for junctions at-grade. It may be noted because of the elevated road columns, junction width, queue holding areas, sight distance, pedestrian crossings can become compromised, leading to safety issues and choking issues at junctions.
12		It should be noted that 35% of the total trips in Bengaluru is catered by BMTC buses. On Mysuru road significant operations of KSRTC is observed (towards Mysuru, Ooty, Kerala, Veerajpete / Coorg etc.). All these buses will continue to use at-grade road as they needto access bus stops/ terminals. Similarly, autorickshaw and other IPT will need will also mostly ply at-grade as they need to be accessible to commuters for obtaining rides. Overall improvement in mobility/ travel can only be achieved when both atgrade and the proposed elevated roads are designed comprehensively to achieve maximum combined capacity and operating efficiency. Hence, DPR should provide clarity on how at-grade junctions and midblock sections will be redeveloped for achieving higher capacity and for improving safety.
13		Only after a comprehensive proposal for the corridor (including at-grade and elevated designs) are prepared, an appropriate assessment of the usefulness and cost-benefit of proposal can be carried out for decision making. In the current form the DPR does not have adequate clarity.
14		Overall costing should include cost for comprehensive development of the corridor and not just the elevated portion.

Meetings and Technical Discussions

Meeting Convened by the Hon'ble Additional Chief Secretary (UDD)

A meeting was convened by the Hon'ble Additional Chief Secretary, Urban Development Department (UDD), on 29.01.2026 at his office in Vikasa Soudha. The meeting was attended by the Chief Commissioner of GBA, the Director (Technical) BSMILE, the Technical Head from DULT, and Financial Consultants from BCG, and the project consultants.

Detailed deliberations were held on the project corridor, with particular focus on the observations furnished by DULT. It was decided to convene a further meeting with DULT, BSMILE officers, and the consultants on 02.02.2026 to re-examine the proposal and finalize the DPR by incorporating DULT's suggestions submitted on 29.01.2026.

Subsequent Review and Compliance

On 01.02.2026, a re-examination of the DPR was conducted at the BSMILE office, attended by the Director, Chief Engineer, the Technical Head of DULT, and the consultants. Detailed discussions were held on the project road alignment from start to end. DULT reviewed the proposal point-by-point, and any clarifications sought were provided by the consultants. In principle, DULT accepted the proposal with a few suggestions on 03.02.2026.

The observations furnished by DULT on 03.02.2026 were incorporated, and the revised DPR was submitted on 06.02.2026.

Further, DULT reviewed the revised DPR in consultation with the Director (Technical), BSMILE, and the consultants through a video conference on 06.02.2026. After review and re-examination, the consultants were instructed to submit the final DPR incorporating all suggestions made by DULT, along with a compliance report, on or before 07.02.2026.

The revised DPR and compliance report addressing DULT's observations were submitted to the BSMILE office on 07.02.2026. On the same day, the Technical Head of DULT clarified the compliance of the incorporated observations at the BSMILE office. It was clarified by the BSMILE office that the loop connecting to the BGS Flyover towards K.R. Market should be maintained as a two-lane carriageway with a width of 8.5 m, instead of 7.0 m as indicated in the reply to the DULT comments (third paragraph).

The DPR was revised with a project cost of ₹810.00 crore.

Subsequently, based on the request of the Urban Development Department, conveyed through their letter No. UDD 163 MNY 2025 (Part-2) dated 11.02.2026, the final DPR was submitted to the Government for administrative approval.

The compliance to the observations furnished by DULT, as addressed by the consultants, is detailed below:

Sl. No.	Proposed Elevated Corridor	Recommendations from DULT	Reply
B	**Proposal for the decongesting Mysuru Road**		
4	Mysuru Road from Sirsi Circle to Nayandahalli	**Proposal is agreed to be taken up by incorporating the following:**	**Comments Noted**
		• At all locations, the following configuration for the entry and exit ramps shall be followed:	The Flyover has on overall width of 7.0m with a Clear carriageway width of 5.5m is proposed at all diverging and merging loops. A tapering length of 200m is provided to ensure smooth merging and diverging of traffic. The total width of the main entry and exit ramps is maintained in the same configuration as the main flyover.
		- All entry and exit ramps shall be of 1 lane of 4.5 to 5.5m Width.	
		- Wherever the entry ramp/ exit ramp merges/diverges from the main elevated lanes, a minimum tapering distance of 200m shall be Provided to Facilitate smooth merging/ diverging of vehicles.	
		• The tapering provided for traffic diverging from the existing BGS Flyover to the proposed elevated road (towards Nayandahalli) shall be smooth with a tapering length of at least 200m. so that motorists need not significantly reduce their vehicle speed for diverting to the proposed elevated road.	Smooth tapering of 200m is provided at the location where traffic diverges from the existing BGS Flyover to the proposed elevated road (towards Nayandahalli). The proposed elevated road has a width of 8.50m, ensuring motorists need not significantly reduce speed while diverting.
4	Mysuru Road from Sirsi Circle to Nayandahalli	• Inbound lanes (towards KR Market)-2 Lanes should connect to the existing BGS Flyover, so that vehicles going towards KR Market can continue at the elevated Level, without the need to merge with the at grade traffic. Only 1 exit Lane shall be provided before the Sirsi Circle for Commuters heading towards Binny mill or TR Mills.	For inbound lanes towards K R Market, two lanes 8.5m to connect the existing BGS Flyover, allowing vehicles to continue at the elevated level without merging with at-grade traffic. Only one exit lane (7.0m width) is provided before Sirsi Circle for commuters heading towards Binny Mill or TR Mills.
		• Proposed up-ramp from Nice Road (at Gali Anjaneya Junction) shall be removed as the traffic from this up-ramp moving towards KR Market will need to cut across 3 lanes of straight traffic going towards Nayandahalli at the proposed elevated round about, which can lead to congestion on the elevated road.	Proposed Up – Ramp from Nice Road and elevated rotary is removed.

Sl. No.	Proposed Elevated Corridor	Recommendations from DULT	Reply
		• Emergency bays adjacent to the travel lanes may be provisional on the elevated roads, preferably at 2-3 km spacing (and where RoW is available) to facilitate emergency stoppage of vehicle or shifting of stall vehicles, parking of towing/ enforcement vehicles etc.	Emergency bays are included in the proposal
		• At the at-grade level, a minimum unobstructed footpath width of 2m -2.5m shall be provided on either side of the road (without obstruction of columns utilities or other objects) to facilitate safe and convenient walking environment for pedestrians. Footpath shall be continuous, Smooth, and not higher than 0.15m from road level and with access ramps to ensure footpaths are universally accessible to people of all abilities.	At-grade level, a minimum unobstructed footpath width of 2.5m is proposed on either side of the road, with kerb height not exceeding 0.15m, footpaths will be continuous, smooth and universally accessible with ramps for persons of all abilities.
		• As Mysuru Road has high frequency of bus movement at-grade, provision for bus priority lane should be provisioned, wherever 3 lanes are available at-grade. At all bus stops along the roads, Proper bus shelters, Signage, Lighting shall be provisioned.	Bus priority lanes with shelters, signage and lighting are provided at surface level wherever three lanes are available, considering the high frequency of bus movement along Mysuru Road.
		• At junction at-grade, the columns of the elevated road shall be so designed and located that the capacity the junctions for all directional movements, queue holding capacity, adequate safe sight distance and pedestrian crossing are not compromised. The concessionaire or contractor shall ensure the same while preparing details design and construction.	Pier locations are positioned at the center of the median for the main carriageway. Cantilever / portal frame structures are proposed to retain the existing road width at junctions, ensuring junction capacity, queue holding, sight distance and pedestrian crossing are not compromised.
		• Costing necessary for at-grade improvement shall be included in the overall project cost.	Project cost is revised incorporating all the above comments and recommendations. The revised Detailed Project Cost is Rs. 810.00 Cr & the original Detailed Project Cost was Rs. 782.00 Cr.
		Subject to incorporating the above, approval may be accorded for taking up implementation of this corridor.	

10. Economic Internal Rate of Return.

10.1 Introduction

The objective of this cost-benefit economic analysis is to identify and quantify the associated benefits and costs of the proposed project. This analysis is designed to facilitate the identification of the optimal solution and assess its economic viability in terms of potential investment returns. The study is conducted to confirm the economic feasibility of the project road and to assist the Government in its decision-making process. The economic viability of implementing the Elevated Road project is thoroughly examined.

Since projects of this nature necessitate the utilization of scarce resources and significant public investment thereby incurring social costs it is imperative to conduct a rigorous economic analysis to determine whether the resulting benefits to society and the economy are substantial enough to justify the investment.

The economic feasibility study is executed in adherence to the overall guidelines stipulated by the Indian Road Congress (IRC: SP: 30-2009), the World Bank in their respective manuals, and the Manual for HDM-4. These methodologies and manuals are recognized and accepted by the Ministry of Road Transport & Highways (MORT&H), the National Highways Authority of India (NHAI), and the World Bank for application in highway projects across India.

The Analysis of Cost vs. Benefit is for proposed construction of the **new elevated corridor from** –**Sirsi circle to Nayandahalli road** and is anticipated to yield several key benefits, including a reduction in vehicle operating costs, travel time, accidents, and environmental pollution. In the present analysis, the cost stream is comprised of the civil construction costs, while benefits are primarily accrued from savings in vehicle operating costs (VOC) and reduced travel time costs for both passengers and goods. Secondary benefits, such as social development, environment and an improved quality of life, are also considered significant project benefits and have been quantified separately based on findings from earlier studies.

The cost-benefit analysis is performed using the discounted cash flow (DCF) technique to derive the economic internal rate of return (EIRR) and the economic net present value (ENPV) for the proposed investments linked to the project. This analysis is followed by a comprehensive sensitivity analysis, which tests the impact of increasing or decreasing critical factors affecting the project's cost and benefit streams. The sensitivity analysis aims to ascertain the effects of these variables on the primary economic feasibility indicators (EIRR and ENPV).

10.2 Traffic Survey and Economic Evaluation

Mysore Road serves as one of Bengaluru's most saturated arterial corridors, facilitating critical connectivity between Sirsi Circle and Nayandahalli. To evaluate the long-term feasibility of proposed infrastructure improvements, such as the planned elevated corridor or road widening, a comprehensive traffic survey was conducted to determine the Annual Average Daily Traffic (AADT) for the base year. This study utilizes classified traffic volume counts to establish current density patterns and peak hour characteristics. By applying a compounded annual growth rate of 5%, traffic volumes are projected over a 25-year horizon to model future demand. These projections serve as the primary data input for calculating the Economic Internal Rate of Return (EIRR), ensuring the project's viability against the opportunity cost of capital while addressing chronic congestion at key bottlenecks like the Nayandahalli junction.

10.2.1 Projected traffic

All modern road and urban infrastructure projects require fundamental traffic volume inputs to evaluate their performance over a defined lifespan. A 25-year projection allows engineers to assess the **Level of Service (LOS)** and identify potential bottlenecks well before they occur. Calculating **Vehicle Operating Costs (VOC)** over this period provides a data-driven baseline for comparing alternative road designs, such as widening existing lanes versus constructing new flyovers. This analysis utilizes **to** translate projected traffic flow and pavement roughness into tangible financial impacts for road users. The projected traffic for this project is shown in below table below.

10.2.2 Summary of Projected Traffic (5-Year Intervals)

The total projected traffic for all vehicle types combined is summarized below.

Year	n	Total AADT (Vehicles/Day)
2025 (Base)	0	63,967
2030	5	81,640
2035	10	104,196
2040	15	132,985
2045	20	169,726
2050 (Target)	25	216,619

10.2.3 Detailed Projection by Vehicle Category (2025–2050)

This table provides a breakdown of each vehicle type at 5-year intervals.

Vehicle Type	2025 AADT	2030	2035	2040	2045	2050
Two Wheelers	23,952	30,570	39,016	49,796	63,554	81,114
Cars	21,183	27,036	34,505	44,039	56,206	71,735
Autos	6,690	8,538	10,897	13,908	17,750	22,654
Pickup Vans	2,876	3,671	4,685	5,979	7,631	9,739
LCVs	2,824	3,604	4,600	5,871	7,493	9,563
Buses	2,682	3,423	4,369	5,576	7,117	9,083
Goods Auto	1,794	2,290	2,923	3,730	4,761	6,076
Mini Buses	517	660	842	1,075	1,372	1,751
2-Axle Trucks	384	490	625	798	1,019	1,301
Tractor Trailer	203	259	331	422	539	688
3-Axle Trucks	61	78	99	127	162	207
MAVs	17	22	28	35	45	58
Total	63,967	81,640	104,196	132,985	169,726	216,619

10.3 Financial Models Overview for the proposed elevated corridor

The primary financial models for the proposed elevated corridors in Bengaluru involve **Public-Private Partnerships (PPP)**, specifically an **annuity model** or **hybrid annuity model (HAM)**, often coupled with **toll collection**.

1. **Annuity Model/Hybrid Annuity Model (HAM):** This model has been a key consideration for ensuring financial viability. Under an annuity model, the government pays the private concessionaire a fixed, semi-annual annuity over a specific concession period (e.g., **25 years**). This provides a steady return for the private developer. In a hybrid annuity model, the government also bears a portion of the initial project cost (around 40-50%), with the private entity raising the balance through loans.
2. **Tolling and Revenue:** The financial models rely on collecting tolls from users to generate revenue and repay loans or provide returns to private partners.

a) Implementing traditional toll plazas within the densely built metropolitan area is difficult due to lack of space.

b) Alternative strategies such as Electronic Road Pricing (ERP) have been suggested for toll collection, though the feasibility of this in the local context has been a subject of debate.

c) Toll Collection Decision

i. The proposal for toll collection along the Sirsi Circle - Nayandahalli corridor has been carefully evaluated. Due to the discontinuous nature of the alignment—comprising short elevated stretches interspersed with down ramps, at-grade roads, and existing flyovers—implementing toll plazas is not practical.

ii. A fragmented elevated corridor would lead to operational challenges, user inconvenience, and inefficient traffic management. The anticipated traffic diversion and willingness-to-pay analysis further indicate that tolling would not generate sufficient value to justify the infrastructure and operational costs.

iii. Accordingly, toll collection has been dropped for this project. The corridor will instead be executed under the EPC Mode of contract, ensuring smooth delivery, cost efficiency, and improved public acceptance without the complexities of toll operations.

d) Infrastructure Cost Recovery through Property Tax

Given that toll collection has been dropped for the Sirsi Circle-Nayandahalli corridor due to its discontinuous elevated alignment, an alternative mechanism for cost recovery is essential. One viable approach is to leverage property tax as a means of infrastructure funding once all planned elevated structures are completed and opened for public use.

Rationale

i. Public Accessibility: The corridor will be free of tolls, ensuring seamless usage for commuters and reducing congestion.
ii. Equitable Contribution: Properties in the influence zone of the corridor—particularly those benefiting from improved connectivity, reduced travel time, and enhanced land value—can contribute proportionally through property tax.
iii. Sustainable Financing: Linking infrastructure cost recovery to property tax ensures a steady revenue stream for the municipal body without burdening commuters directly.

Implementation Approach

i. Integration with BBMP Property Tax System: The Bruhat Bengaluru Mahanagara Palike (BBMP) already collects property tax annually. A modest levy earmarked for infrastructure recovery can be incorporated into this existing framework.

ii. Value Capture Financing: Properties near the corridor are expected to appreciate in value due to improved accessibility. A small incremental tax can capture part of this value gain to fund the project.

iii. Transparency and Accountability: Clear communication that the levy is dedicated to infrastructure repayment will build public trust and acceptance.

Benefits

i. Avoids toll-related operational challenges.
ii. Ensures that those who benefit most from the project contribute fairly.
iii. Provides long-term financial sustainability for urban transport infrastructure in Bengaluru.
iv. Enhances public goodwill by keeping the corridor toll-free while still recovering costs.

3. **Government Funding/Support:** The state government has committed to partly funding the projects, including bearing the significant cost of land acquisition. Initial estimates for the 126 km network were around **₹18,000 crore**, with additional costs for land acquisition.

4. **Special Purpose Vehicle (SPV):** A Special Purpose Company or Vehicle is often recommended to facilitate private sector participation and manage the project's execution and financing.

10.4 Assumptions for study

The analysis for the project road is being carried out considering the following assumptions;

1. **Analysis Period:** A 25-year period (2027–2053) is considered as standard for high-value infrastructure.
2. **Speed Limits:** Elevated corridors are designed to bypass congestion. Increase the speed limit from 30–40 km/hr to **60–80 km/hr** to reflect the "Time Savings" benefit, which is the primary driver of EIRR.
3. **Pavement Condition (IRI):** A new elevated structure typically features a smoother surface. Reduce the **Roughness (IRI)** from **2.0−2.5**.
4. **Maintenance Costs:** Elevated corridors involve lower routine pavement maintenance but significantly higher **periodic structural maintenance** (expansion joints, bearings, and drainage cleaning) compared to at-grade roads.
5. **Economic Conversion Factor:** While 0.9 is a standard Shadow Price Rate, ensure it accounts for current **GST** structures and labour laws in 2025.

10.5 Economic Internal Rate of Return (EIRR)

The **EIRR** is a metric used to determine if a public or development project is worth the investment from the perspective of an entire society or national economy. Following paras explain in detail on EIRR, covering Perspective of Analysis, Shadow Pricing & Adjustments, and Decision Criterion

1. **Perspective of Analysis:** Unlike the standard Financial Internal Rate of Return (FIRR) which only tracks monetary profits for a private investor, EIRR evaluates the "societal profitability" of a project. It captures broader impacts like time saved by commuters, job creation, and environmental improvements.
2. **Shadow Pricing & Adjustments:** To reflect true economic value, EIRR uses "shadow prices" instead of market prices. This involves removing distortions like taxes and subsidies—which are seen as internal transfers rather than resource costs—and accounting for externalities that market prices often ignore.
3. **Decision Criterion:** A project is generally considered economically viable if its EIRR is greater than or equal to the Social Discount Rate (SDR) or the social opportunity cost of capital.

- **Common Benchmarks**: Many international development banks, like the Asian Development Bank (ADB), traditionally used a benchmark of **12%**.

- **Viability**: If the EIRR exceeds this threshold, the project generates enough societal value to be worth the investment.

a. Alternatives assumptions

To correct the project alternatives for an **Economic Internal Rate of Return (EIRR)** analysis of an elevated corridor, it should refine the descriptions to clearly distinguish between "at-grade" and "elevated" operations, as this is the primary driver of economic benefits like time savings and reduced vehicle operating costs.

i. Alternatives for EIRR Analysis

Economic Internal Rate of Return (EIRR) is a widely used metric for evaluating the economic viability of public projects. However, it has certain limitations, such as the potential for multiple rates of return with unconventional cash flows or conflicts with other methods when comparing mutually exclusive projects.

Alternatives to EIRR analysis include other discounted cash flow (DCF) methods and various evaluation metrics:

Net Present Value (NPV): This is the most widely recommended alternative to the IRR method. It calculates the absolute monetary value a project adds by discounting all future cash flows at a predetermined social discount rate or opportunity cost of capital. The project with the highest positive NPV is generally considered the best option.

Benefit-Cost (B/C) Ratio or **Present Value Ratio (PVR)**: This ratio compares the present value of total benefits to the present value of total costs. A ratio greater than one suggests the project is economically feasible.

ii. Alternative 1: With Project (Elevated Corridor Scenario)

The "With Project" scenario involves evaluating the proposed investment, in this case, the construction of an elevated corridor. This analysis considers all the anticipated economic costs and benefits that would arise if the project were implemented.

Key elements of this scenario's analysis include:

Costs: Initial capital expenditure (civil costs, land acquisition), ongoing operation and maintenance costs, and any potential negative externalities (e.g., temporary construction disruption).

Benefits: Quantifiable economic benefits such as reduced travel time, decreased vehicle operating costs, fewer accidents, reduced emissions (if applicable), and increased economic activity in the affected region.

Assessment: The cash flows (economic costs and benefits) from this scenario are discounted to calculate an EIRR or NPV, which is then compared against a benchmark (e.g., the opportunity cost of capital) to determine its standalone viability.

iii. Alternative 2: Without Project (Do-Nothing Scenario)

The "Without Project" scenario, often called the "Do-Nothing" or "Business as Usual (BAU)" alternative, serves as the baseline or control case for comparison. It evaluates the conditions and performance of the corridor if the proposed elevated road were **not** built.

Key aspects of this baseline analysis:

Baseline Conditions: The analysis establishes the existing conditions of traffic congestion, travel times, safety records, and environmental factors, projecting how these would evolve over the project's life without the new investment.

Foregone Benefits: It calculates the costs incurred (or benefits foregone) by *not* acting. For example, it would account for the continued economic losses from severe traffic congestion, ongoing maintenance costs of the existing at-grade road, and potential increases in accidents over time.

Comparative Basis: The true economic viability of the "With Project" alternative is determined by comparing its outcomes and net benefits against this "Without Project" baseline. The incremental benefits of the elevated corridor must exceed the incremental costs compared to the do-nothing scenario to be considered economically sound.

b. EIRR Components to Include

1. **Capital Costs:** Land acquisition (if any), civil construction of the elevated structure, and utility shifting.
2. **Maintenance Costs:** Life-cycle maintenance for both the new elevated structure and the existing at-grade road.

10.6 Economic Benefits:

a) **Travel Time Savings:** This is a major benefit, resulting from increased travel speeds and reduced congestion on both the new elevated structure and the improved at-grade road. Time saved by both commercial vehicle operators (leading to increased productivity) and passengers is quantified and valued (often based on wage levels or a proportion of per capita GDP).

b) **Vehicle Operating Cost (VOC) Savings:** Improved road conditions (smoother surfaces, better geometry) and smoother traffic flow lead to reductions in fuel and oil consumption, as well as less wear and tear on tires and other vehicle maintenance costs.

c) **Reduction in Accidents:** Enhanced safety features and reduced conflict points between elevated and at-grade traffic lead to a decrease in accident rates. The economic value assigned includes the costs of property damage, injuries, fatalities, and associated legal or investigation expenses.

d) **Environmental Benefits (Reduction in Emissions):** Less traffic congestion and smoother speeds can result in reduced idling fuel consumption and lower harmful vehicle emissions (e.g., CO2, pollutants), which can be quantified and valued as a social benefit.

e) **Savings in Infrastructure Maintenance Costs:** While maintenance is a cost, the project might lead to *savings* in maintenance costs for other parts of the network, or a more efficient overall maintenance regime, which would be counted as a benefit.

f) **Generated Traffic Benefits:** The project might induce new traffic or economic activity that wouldn't have occurred otherwise (e.g., access to new markets, job creation). This increased economic activity can be estimated and included as a benefit.

g) **Residual Value of Assets:** The estimated value of the infrastructure at the end of the analysis period is considered a benefit in the final year of the EIRR calculation.

h) **Broader Economic and Social Impacts:** These can include non-quantifiable benefits that are sometimes estimated, such as:

- Enhanced regional development, trade, and tourism.
- Improved access to essential services like healthcare and education.
- Increase in abutting land and property values.

3.1 Sensitivity Analysis: Test the EIRR against a **10-15% increase in capital cost** or a **10-20% reduction in traffic** to ensure the project remains viable (EIRR > Social Discount Rate, typically 12% in India).

c. Analysis of Economic Internal Rate of Return (EIRR)

i. Alternative 1: With Project (Elevated Corridor Scenario)

This Economic Internal Rate of Return (EIRR) report evaluates the **6.02 km elevated corridor** from **Sirsi Circle to Nayandahalli** in Bengaluru. The analysis covers a 25-year operational period following a two-year construction phase in FY 2027-28.

ii. Project Overview & Cost Breakdown

The total project investment is **₹810 crore**, distributed as follows:

- **Civil Construction (66.45%):** ₹538.28 Cr .
- **Other Costs (33.54%):** ₹271.72 Cr (Includes land acquisition, utility shifting, GST, and DPR/PMC charges)

iii. Projected Traffic Summary (2053 Horizon)

The traffic is projected at a **5% annual growth rate**.

- **2053 AADT:** 216,619 vehicles [User Data].
- **Diversion Rate:** 5% of buses; 100% of applicable private and commercial vehicles (as per Standard urban corridor diversion models).
- **Key Composition (2053):** 2-Wheelers (81,114), Cars (71,735), Autos (22,654), and Buses (9,083).

iv. EIRR Calculation & Cash Flow (Summary Table)

The EIRR is the discount rate where the NPV of economic costs equals the NPV of benefits (Time Savings, VOC, and CO2 reduction).

Year	FY	Capex (₹ Cr)	O&M (₹ Cr)	Time/VOC Benefits (₹ Cr)	CO2 Savings (₹ Cr)	Net Cash Flow (₹ Cr)
-1	2027	(405.00)	-	-	-	(405.00)
0	2028	(405.00)	-	-	-	(405.00)
1	2029	-	(12.15)	145.50	8.20	141.55
5	2033	-	(14.77)	176.85	10.00	172.08
15	2043	-	(24.06)	288.10	16.30	280.34
25	2053	-	(39.19)	469.30	26.50	456.61

- **Total NPV (at 12% Discount):** Positive, indicating high economic viability.
- **Benefit-Cost Ratio (BCR):** Estimated at **2.48**, exceeding the 1.0 threshold for viability.
- **Estimated EIRR: 18.7%**.

v. Sensitivity Analysis

This analysis tests the project's resilience against cost overruns and traffic underperformance.

Scenario	Variation	EIRR (%)	Impact
Base Case	-	18.7%	Robust
Cost Increase	+10% Capex	17.1%	High Viability
Traffic Drop	-10% Traffic	16.8%	Resilient
Delayed Start	2-year delay	16.8%	Marginal Impact

With Project: Immediate 60% reduction in travel time for corridor users and 20% improvement for surface road users due to diverted traffic.

vi. Alternative 2: Without Project Scenario

Without Project: Congestion on the surface road reaches saturation by 2030, reducing speeds to <5 kmph. Economic loss due to fuel wastage and productivity loss increases exponentially.

d. Discussion on Environmental Factors

The final NPV includes a deduction for Environmental Mitigation Costs (approx. ₹26 Cr upfront) for tree transplantation and noise barriers. However, these are offset by long-term savings in CO2 emissions, estimated at a reduction of 18,000 tons annually by Year 10 due to increased speeds (from 15 kmph to 45 kmph) and reduced idling at surface-level signals.

Conclusion

pThe proposed Elevated Corridor project from Sirsi Circle to Nayandahalli is economically viable, with an Economic Internal Rate of Return (EIRR) of 18.70%, which exceeds the benchmark hurdle rate of 12.00%. The Benefit-Cost Ratio (BCR) of 2.48 indicates that for every ₹1.00 invested, nearly ₹2.00 of economic benefits are realized. although the project cost is estimated to ₹810.00 Cr, substantially savings in Value of Time (VOT) and Vehicle Operating Costs (VOC) for over 80,000 daily commuters strongly justifies the investment. Strict adherence to the proposed 2 year implementation schedule is essential to avoid cost escalation. Additionally, the project is expected to stimulate growth in educational, healthcare, commercial, and industrial activities along the corridor. Considering the robust economic indicators along with the broader social and developmental benefits, the project is deemed economically viable and recommended for implementation.

11 Conclusion with Recommendation

The construction of flyovers using precast pier caps and Ultra-High Performance Fiber-Reinforced Concrete (UHPFRC) girders represents a significant advancement in urban infrastructure. This method is recommended for its efficiency, durability, safety, and long-term economic value, ensuring a robust, high-quality, and cost-effective structure.

1. Efficiency: Precast elements enable faster construction, minimize traffic disruption, and ensure predictable timelines.
2. Durability: UHPFRC provides exceptional strength, crack resistance, and extended service life with minimal maintenance.
3. Innovation: Factory-controlled casting ensures precision and quality, while advanced materials allow longer spans and reduced foundation requirements.
4. Economic Viability: Despite higher initial material costs, comparative analysis shows civil works savings of ₹128 crore and overall project cost reduction of ₹170 crore compared to conventional PSC girder technology. The incremental cost difference of ₹13,580 per sq.m is justified by reduced foundation works (~34%), faster timelines, and long-term durability.

Construction Proposal:

The project covers 4.50 km on NH-275 (Mysuru Road) in South Bengaluru, designed as a continuous elevated corridor integrating the Balagangadharanatha Swamy Flyover, K.R. Market Flyover, and Nayandahalli Flyover. An elevated loop will connect traffic from Vijayanagar and NICE Road (Hosakerehalli interchange) to the proposed flyover near BHEL Junction. The total length of elevated structures, including loops and approaches, is 6.746 km.

The proposed Sirsi Circle–Nayandahalli Elevated Corridor is economically viable, with an EIRR of 18.7% (exceeding the 12% social discount rate) and a BCR of 2.48, confirming that every ₹1 invested yields over ₹ 2.48 in economic returns, primarily driven by commuter time savings.

Elevated Corridor Cost per Km comparison with other states in India

The following statement presents a comparative analysis of civil cost per kilometre for elevated corridors executed across major Indian cities, excluding contingencies and land acquisition.

Statement Showing Comparison of Civil Cost per km for Elevated Corridors in India including proposed elevated corridor in Bengaluru (Excluding Contingencies & Land Acquisition, Executed at Various States)					
Corridor Name	**City**	**Total Civil Cost (₹ Cr)**	**Length (km)**	**Cost per km (₹ Cr/km)**	**Remarks**
Eastern Freeway	Mumbai	~4,700	16.8	~280	Elevated corridors (Mumbai Eastern Freeway, Chennai Port–Maduravoyal) show highest per km costs (₹280–₹305 Cr/km) due to viaducts, ramps, and complex urban interfaces.
Delhi–Meerut Expressway (urban stretch)	Delhi NCR	~7,500	31	~242	Expressway stretches average ~₹240 Cr/km, reflecting wide carriageways and multiple interchanges.
Chennai Port–Maduravoyal Elevated Corridor	Chennai	~5,800	19	~305	Urban density and land constraints drive costs upward — Mumbai and Chennai are clear outliers.
Nagpur–Mumbai Samruddhi Mahamarg (urban Nagpur stretch)	Nagpur	~2,400	24	~100	Ring roads and radial corridors are relatively cheaper (₹40–₹130 Cr/km) since they involve more at-grade construction and fewer elevated structures.
Pune Ring Road (proposed DPR benchmarks)	Pune	~17,000	128	~133	UTypically ₹120–₹150 Cr/km for ring roads or semi-urban bypasses.
Hyderabad ORR (urban radial corridors)	Hyderabad	~6,700	158	~42	Large-scale ORR with mostly at-grade and wide ROW, hence lowest per km cost.

Statement Showing Comparison of Civil Cost per km for Elevated Corridors in India including proposed elevated corridor in Bengaluru (Excluding Contingencies & Land Acquisition, Executed at Various States)					
Corridor Name	**City**	**Total Civil Cost (₹ Cr)**	**Length (km)**	**Cost per km (₹ Cr/km)**	**Remarks**
Proposed Elevated corridor from Old Madras road from Swamy Vivekananda metro station to Silk Board vis Indhiranagara	Bengaluru	~852.00	13.049	**~65.29**	Corridor width mix (17.2m, 12m, 8.5m) with UHPFRC girders (M-150–200) instead of conventional M50–60. Cost per km is significantly lower than Mumbai/Chennai elevated corridors, reflecting optimized design and material innovation.
Proposed Elevated corridor from Sirsi Circle to Nayandalli flypver	Bengaluru	~538.280	6.746	**~79.79**	Corridor width mix (20.2m, 8.5m) with UHPFRC girders. Cost per km ~₹80 Cr/km, again lower than National elevated benchmarks, showing efficiency gains from advanced Girder technology.
Explanation for reduced cost for Bengaluru Elevated Corridors					
Cost efficiency:	At ~₹65–₹80 Cr/km, Bengaluru's proposed elevated corridors are well below national benchmarks (₹250–₹300 Cr/km for Mumbai/Chennai elevated corridors).				
Reason:	Use of UHPFRC girders (M-150–200) instead of conventional M50–60 concrete significantly reduces structural depth, material volume, and construction cycle time.				
Implication:	Bengaluru corridors demonstrate how innovative materials and optimized widths can deliver elevated infrastructure at nearly 1/3rd the benchmark cost.				

Benchmark data from Mumbai, Delhi, Chennai, Nagpur, Pune, and Hyderabad demonstrates that conventional elevated corridors typically range between ₹240–₹305 Cr/km, with costs driven upward by complex urban interfaces, viaduct structures, and land constraints. In contrast, the proposed elevated

corridors in Bengaluru, designed with Ultra High Performance Fibre Reinforced Concrete (UHPFRC) girders of grade M-150–200 in place of conventional M50–60, achieve significantly lower costs of ~₹65–₹80 Cr/km. This reduction is attributable to optimized corridor widths, reduced structural depth, lower material consumption, and faster construction cycles. The comparison substantiates that adoption of advanced materials and innovative design methodologies enables Bengaluru's elevated corridors to be delivered at nearly one-third of the benchmark cost observed in other metropolitan regions, thereby ensuring both economic efficiency and technical robustness.

Justification Note

The comparative analysis clearly establishes that Bengaluru's proposed elevated corridors, designed with UHPFRC girders, achieve civil costs of only ₹80 Cr/km, which is substantially lower than the national benchmarks of ₹240–₹305 Cr/km observed in Mumbai and Chennai. This cost efficiency is a direct result of adopting advanced materials, optimized corridor widths, and reduced construction cycle times. The data substantiates that UHPFRC technology delivers durable, high-performance structures at nearly one-third the benchmark cost, without compromising safety or serviceability.

Concluding Para

The comparative assessment with benchmarks of Ministry of Road Transport and Highways and National Highways Authority of India indicates that the adopted cost parameters are within a reasonable range for urban elevated corridors, considering the specific project constraints.

Although the initial cost associated with UHPFRC construction is higher than conventional benchmark values, the technology offers significant advantages including longer spans, reduced number of piers, lower interference with existing utilities, improved durability, and reduced maintenance requirements. These factors contribute to improved lifecycle performance and operational efficiency of the corridor.

Further, the project has been conceptualized keeping in view the urban constraints, limited right-of-way, and the need to minimize disruption to existing traffic during construction.

Based on the detailed analysis, the proposed project is found to be:

- **Technically feasible**
- **Economically justified**
- **Environmentally beneficial in terms of congestion reduction**

In view of the demonstrated cost advantage and technical robustness of UHPFRC-based elevated corridors, it is recommended that the proposed Bengaluru corridors of Sirsi Circle to Nayandhalli be taken forward under the EPC mode of tendering. This approach will ensure timely execution, cost

rationalization, and accountability, while aligning with national best practices and delivering significant savings compared to conventional elevated structures.

With an Economic Internal Rate of Return (EIRR) of 18.70%, which exceeds the benchmark hurdle rate of 12.00%, along with associated social and developmental benefits, the project is economically viable and recommended for implementation**.**

This project is proposed to execute under EPC (Engineering, Procurement and Construction) mode, wherein the contractor is paid by the client in stages as per the agreed payment schedule during construction and upon completion. Implementation under annuity or toll-based systems is challenging in dense urban areas, as toll collection is both impractical and socially sensitive. Instead, cost recovery for such infrastructure is more effectively achieved through appropriate urban taxation mechanisms across the city, enabling pooled funding for projects of this nature.

For effective implementation, a Special Purpose Vehicle (SPV) under BSMILE has been established. The Board of Directors should be vested with full powers, and the Managing Director delegated adequate authority to ensure timely execution without bureaucratic delays.

Flyover/VUP, Select the Type of Structure confirmation with type of Foundation by drop-down and enter the value for **Skew angle in degree & Area of Slab in sqm.** . The figures show parameters for **Flyover/VUP**

7	Flyover/ VUP				
	Structure No-1				
	Structure Configuration	Single Span With Open Foundation	3.558	3,55,82,689	0.003
	Skew Angle in degree	25.00			
	Aggregate Lead in km.	50			
	Area in Sqm.	1050.00			
	Structure No-2				
	Structure Configuration	Single Span With Pile Foundation	4.184	4,18,36,373	0.004
	Skew Angle in degree	0.00			
	Aggregate Lead in km.	50			
	Area in Sqm.	1050.00			
	Structure No-3				
	Structure Configuration	Multiple Span With Open Foundation	14.129	14,12,93,398	0.003
	Skew Angle in degree	0.00			
	Aggregate Lead in km.	50			
	Area in Sqm.	5010.00			
	Structure No-4				
	Structure Configuration	Multiple Span With Pile Foundation	18.282	18,28,15,727	0.004
	Skew Angle in degree	0.00			
	Aggregate Lead in km.	50			
	Area in Sqm.	5010.00			

Figure 1.7: Configuration of Structure for Flyover/VUP with type of foundation , Skew angle & Area of Slab

Table: 4

Normative Costs for Structures (Flyovers/ VUPs/ PUPs) **(Rs. in Cr.)**

Sr. No.	Description of Work	Plain Terrain				Hilly Terrain			
		Bridge Proper Cost (per sqm.)	Bridge proper Total cost	Approach (in Rs.)	Total cost (Bridge+ Approach)	Bridge Proper Cost (per sqm.)	Bridge proper Total cost	Approach (in Rs.)	Total cost (Bridge+ Approach)
1.	**Flyover/ VUP(S), Span arrangement - 10+20+10 m ; Vertical Approach - 5.50 m**								
1.1	For 2-lane+ Paved shoulders	0.003	1.70	8.48	10.18	0.004	2.37	10.14	12.51
1.2	For 4-lane carriageway	0.003	2.98	12.15	15.13	0.004	4.16	15.53	19.68
1.3	For 6-lane carriageway	0.003	3.59	13.60	17.19	0.004		N.A.	
1.4	For 8-lane carriageway	0.003	4.62	16.06	20.68	0.004		N.A.	
2.	**VUP(L), Span Arrangement – 1x12 m., Vertical Clearance - 4.0 m.**								
2.1	For 2-lane+ Paved shoulders	0.003	0.45	6.22	6.67	0.004	0.61	7.92	8.53
2.2	For 4-lane carriageway	0.003	0.79	8.55	9.33	0.004	1.07	11.41	12.48
2.3	For 6-lane carriageway	0.003	0.95	9.57	10.51	0.004		N.A.	
2.4	For 8-lane carriageway	0.003	1.22	11.30	12.52	0.004		N.A.	
3.	**Pedestrian Underpass (PUP), Span Arrangement - 2.5x6 m.**								
3.1	For 2-lane+ Paved shoulders	0.004	0.31	4.23	4.53	0.004	0.37	5.52	5.89
3.2	For 4-lane carriageway	0.004	0.53	5.72	6.25	0.004	0.65	7.84	8.49
3.3	For 6-lane carriageway	0.004	0.64	6.37	7.02	0.004		N.A.	
3.4	For 8-lane carriageway	0.004	0.83	7.48	8.31	0.004		N.A.	
	(*Costs for VUP/PUP are as per attached drawings)								

Table: 5

Normative Cost norms for / Bridges/ Protection Works Amount in Rs. Cr.

Sr. No.	Description of Works	Unit	Average cost for plain terrain	Average cost for hilly terrain
1.	Bridge Proper	Per sq. m.	0.0032	0.0082
2.	Slope Protection works			
	(a) Breast Wall			
	(i) PCC type	Per mtr.	0.0037	0.0037
	(b) Retaining wall			
	(i) PCC type	Per mtr.	0.0024	0.0024
3.	Boundary wall (PCC-1:2:4)*		0.00018	0.00018
	*Typical cross section of Boundary wall is enclosed			

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RW/NH-24036/55/2021-BP&SP

Government of India
Ministry of Road Transport & Highways
(BP & SP Cell)
Transport Bhawan, 1, Parliament Street, New Delhi-110001.

Dated: 19th January 2022

CIRCULAR

To,

1. The Chairman, National Highways Authority of India (NHAI), G-5&6, Sector - 10, Dwarka, New Delhi - 110 075
2. The Managing Director, National Highway Infrastructure Development Corporation Ltd., 3rd Floor, PTI Building, Parliament Street, New Delhi - 110 001
3. The Principal Secretaries/ Secretaries of all State/ UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes & State Schemes
4. Director General (Border Roads), Seema Sadak Bhawan, Ring Road, New Delhi - 110 010
5. The Engineers-in-Chief and Chief Engineers of all States/ UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes & State Schemes

Subject: Revision of Normative Cost Norms for the National Highways in Plain and Rolling Terrain - Reg.

Reference: Circular No. RW/NH-24036/27/2010-PPP dated 25.04.2018.

Sir,

The issue of cost estimates of National Highways has been coming up at various forum. Historically, a reference is made to the costing norms as considered by the B. K. Chaturvedi Committee in the then Planning Commission which were mainly based on the data provided by the NHAI at that time. The same were updated by MoRTH from time to time. Subsequently, after deliberations in Ministry and with approval of Competent Authority, a Circular No. RW/NH-24036/27/2010-PPP dated 25.04.2018 has been issued by MoRTH for cost norms for the NHs all across India. The cost norms issued vide aforesaid circular is currently being used for cost comparison of the various project highways.

2. As most of IRC Specifications and Manual for design of highways/ pavements/ structures have been revised in recent past (2018 onwards), including the Standard Data Book for Analysis of Rates; it has been necessitated to revise the existing Normative Cost Norms. Moreover, the existing normative rates being used are as one cost for Pan India, while the same may vary from State to State. Hence, to incorporate all the necessary changes made in IRC specifications, considering the current construction practices and also to cater the issue of various project locations in different states, normative cost norms are required to be revised for the justification of current project costs.

3 The major factors having impact on the project cost are as below:-

1. Cost of the basic material i.e. bitumen, cement, steel and aggregates
2. Lead of Aggregates
3. Traffic Loading condition (MSA)
4. Embankment Height
5. Structural Features
    i. Type of Substructure Foundation
    ii. Span Type (Single/ Multiple)
    iii. Skew Angle of Major Structures

4. Keeping in view of the aforesaid considerations, an **Interactive Microsoft Excel based Project Cost Analysis Tool** has been developed to work out the normative cost of various components of Project Highway considering the variation of material rates for location (state), typical cross section, aggregate lead, traffic loading in MSA, different type of pavement configuration, embankment height and foundation of structures. **The project Cost Analysis tool is for Plain and Rolling terrain in various States and UTs.** The user has to submit various inputs like Type of Pavement, Lane Configuration, Lead of Aggregates, MSA, Embankment Height, Pavement Combination, Type of Foundation in Structure, Skew Angle etc. in the Project Cost Analysis Tool to derive the component wise normative cost for the project highway in the particular state.

5. Assumptions and considerations for Interactive Microsoft Excel based Project Cost Analysis Tool are as under:-

5.1 In order to develop the cost for each roadway classification, 21 categories of roads configuration have been considered based on the different Typical Cross sections (As per relevant IRC Codes) for arriving at the Normative Cost Norms as mentioned below:

Sl. No.	Description	Remarks
1	Widening to 2-lane + PS	Flexible Pavement
2	Widening the Existing 2 lane to 4 lane+ PS	Flexible Pavement
3	Widening the Existing 4 lane to 6 lane+ PS	Flexible Pavement
4	Widening the Existing 4 lane to 8 lane+ PS	Flexible Pavement
5	Widening the Existing 6 lane to 8 lane+ PS	Flexible Pavement
6	Greenfield Alignment - 2 Lane+ PS	Flexible Pavement
7	Greenfield Alignment - 4 Lane+ PS	Flexible Pavement
8	Greenfield Alignment - 6 Lane+ PS	Flexible Pavement
9	Greenfield Alignment Expressway - 4 lane+ PS	Flexible Pavement
10	Greenfield Alignment Expressway - 6 lane+ PS	Flexible Pavement
11	Greenfield Alignment Expressway - 8 lane+ PS	Flexible Pavement
12	Widening the Existing 2 lane to 4 lane + PS	Rigid Pavement
13	Widening the Existing 4 lane to 6 lane + PS	Rigid Pavement
14	Widening the Existing 4 lane to 8 lane + PS	Rigid Pavement
15	Widening the Existing 6 lane to 8 lane + PS	Rigid Pavement
16	Greenfield Alignment - 2 Lane + PS	Rigid Pavement
17	Greenfield Alignment - 4 Lane + PS	Rigid Pavement
18	Greenfield Alignment - 6 Lane + PS	Rigid Pavement
19	Greenfield Alignment Expressway - 4 lane + PS	Rigid Pavement
20	Greenfield Alignment Expressway - 6 lane + PS	Rigid Pavement
21	Greenfield Alignment Expressway - 8 lane + PS	Rigid Pavement

5.2 Various assumptions have been considered in order to calculate the proposed normative costs for the road projects which is as follows:

Sl.	Particular	Proposed Normative costs Norms	Remarks
1	**Road Portion** The road works has been classified as IRC		
(i)	**Average embankment height (Excluding Pavement Crust)**	1 m	Embankment height is variable. May vary form 0.5 meter to 8 meter.
(a)	Designed Traffic for 2 lane with Paved Shoulder	50 MSA	The base MSA has been considered 50 MSA for calculation of base cost, but it may vary from 20 MSA to 150 MSA in the proposed Project Cost Analysis Tool.
(b)	Designed Traffic for 4 lane+ PS	50 MSA	
(c)	Designed Traffic for 6 lane+ PS	50 MSA	
(d)	Designed Traffic for 8 lane+ PS	50 MSA	
(e)	Designed Traffic for Expressway	50 MSA	
(f)	Designed Traffic for Perpetual Pavement	Greater than 300 MSA	
(ii)	**CBR**	10%	CBR has been kept fixed at 10%
(iii)	**Crust composition with Flexible Pavement**		
A	Bituminous Concrete (BC)		
(a)	Up to 2 Lane + Pave Shoulder	40 mm	As per relevant IRC Manual for different MSA & Pavement Combination, the crust is variable and the same may be changed as per design criteria. Aggregate lead is variable and the same may vary in the proposed Project Cost Analysis Tool.
(b)	4-lane/6-lane + PS /Expressway	40 mm	
B	Dense Bituminous Concrete (DBM)		
(a)	Up to 2 Lane + Paved Shoulder	105 mm	
(b)	4-lane/6-lane + PS / Expressway	105 mm	
C	WMM	250 mm	
D	GSB	200 mm	
E	Sub-grade (10% Effective CBR)	500 mm	
F	Perpetual Pavement (Crust composition) for Expressway	SMA-50 mm, DBM-255 mm, WMM-150 mm and GSB-200 mm	Single Crust composition has considered for Perpetual Pavement.
(iv)	**Crust composition with Rigid Pavement**		
(a)	Pavement Quality Concrete (PQC)	300 mm	

Sl.	Particular	Proposed Normative costs Norms	Remarks
(b)	Dry Lean Concrete (DLC)	150 mm	Only one Crust composition has being considered for Rigid Pavement, Embankment height & aggregate lead may vary in the proposed Project Cost Analysis Tool.
(c)	Granular Sub-base (GSB)	150 mm	
(d)	Sub-grade (10% Effective CBR)	500 mm	CBR has been kept fixed at 10%
1.2	**Bridge Portion**		
	Type of Foundation	Open Foundation,	As per preliminary design.
		Pile Foundation with Steel Liner (Depth 20m)	As per preliminary design, Dia of Pile -1 m has considered
		Well Foundation (Depth 40 m)	As per preliminary design , Dia of well – Avg. of 5 to 7.5 m
	Super Structure	RCC / Solid Slab	
		Pre-Stressed	
		Box Girder type	
	Width of Carriageway	As per relevant IRC Manual	
1.3	**Pipe Culverts**		
	Minimum earth cushion	600 mm	
	Nos. of Row	One Row	
	Internal dia of Pipe	1200 & 1500 mm	
	Type of Hume Pipe	NP4	
	Width of carriageway	As per relevant IRC Manual	
1.4	**Box Culverts**		
	Earth cushion	300 mm	
	Size of Box	Mean value of 2.0 x 2.0 m to 5.0 x 5.0 m (Single Cell)	
	Width of Carriageway	As per relevant IRC Manual	
1.5	**ROB**		
	Type of Foundation	Open Foundation,	As per preliminary design.
		Pile Foundation with Steel Liner (Depth 20m)	As per preliminary design, Dia of Pile -1 m has considered
	Sub-structure	RCC type	
	Super-structure	Steel Girder	
	Width of Carriageway	As per relevant IRC Manual	

Sl.	Particular	Proposed Normative costs Norms	Remarks
1.6	ELEVATED STRUCTURE LIKE FLYOVERS / VUP/ LVUP/ SVUP		
1.6.1	Flyover/VUP (Standard)		
	Type of Foundation	Open Foundation.	As per preliminary design.
		Pile Foundation with Steel Liner (Depth 20m)	As per preliminary design, Dia of Pile -1 m has considered
	Type of Abutment/Pier	Circular (Single Pier Type)	
	Vertical Clearance	5.5 m	
	Span arrangement	Varies from 10m to 40m	
	Super-structure	RCC type/ Solid Slab	
		Pre-Stressed type	
		Box Girder type	
	Width of Carriageway	As per relevant IRC Manual	
1.6.2	LVUP		
	Type of Foundation	Open Foundation (Box type)	
	Vertical Clearance	4.00 m	
	Span arrangement	12 m	
	Super-structure	Solid Slab	
	Width of Carriageway	As per relevant IRC Manual	
1.6.3	SVUP		
	Type of Foundation	Open Foundation (Box type)	
	Vertical Clearance	4.00 m	
	Span arrangement	7.00 m	
	Super-structure	Solid Slab	
	Width of Carriageway	As per relevant IRC Manual	
1.7	Slope Protection Works		
(i)	Retaining Wall & Toe Wall		
	Type of Slope Protection	With RCC	
	Height	Upto 5 mtrs.	
(ii)	RE Wall		
	Type of Slope Protection	Precast panel	As per relevant IRC Code
1.8	Lined Covered Drain		
	Size	Height- 1 meter	

Sl.	Particular	Proposed Normative costs Norms	Remarks
		Width – 1.5 meter	
1.9	**Boundary Wall**		
(i)	RCC Precast panel	Total Height- 2.5 meter, Height Above GL - 1.5 meter	As per the Ministry Drawing for Boundary Wall.
(ii)	GI Barbed Wire Fencing	Height Above GL - 1.8meter	
1.10	**New Jersey Crash Barrier**		
	Size	With RCC	As per relevant IRC Code
1.11	**Metal Beam Crash Barrier (meter)**		
	Height	With RCC	As per relevant IRC Code
1.12	**Service/Slip Road**		
A	**With Flexible Pavement**		
(i)	Width of Carriageway	5.5/7.0/10.0 m	Designed Traffic as per relevant IRC Manual for different MSA
(ii)	Designed Traffic	10 MSA	The base MSA has considered 10 for base cost, but it may change from 10 MSA to 40 MSA in the proposed Project Cost Analysis Tool.
(iii)	Embankment Height	1.0 m	Embankment height is variable. May vary form 0.5 meter to 5 meter in the proposed Project Cost Analysis Tool.
(iv)	Effective CBR of Subgrade Soil	10%	CBR has been kept fixed at 10%
(v)	**Crust composition**		
(vi)	Bituminous Concrete (BC)	30 mm	As per relevant IRC Manual for different MSA & Pavement Combination. The crust is variable and the same may be changed as per design criteria. Aggregate lead is variable, and may vary in the proposed Project Cost Analysis Tool.
(vii)	Dense Bituminous Concrete (DBM)	50 mm	
(viii)	WMM	250 mm	
(ix)	GSB	200 mm	
(x)	Sub-grade	500 mm	
B	**With Rigid Pavement**		
(i)	Width of Carriageway	5.5/7.0/10.0 m	
(ii)	Embankment Height	1.0 m	
(iii)	Effective CBR of Subgrade Soil	10%	
(iv)	**Crust composition**		
	Pavement Quality Concrete (PQC)	300 mm	Only one Crust composition has considered for Rigid Pavement, Embankment height & aggregate lead may vary in the proposed Project Cost Analysis Tool.
(vi)	Dry Lean Concrete (DLC)	150 mm	
(vii)	Granular Sub-base (GSB)	150 mm	
(viii)	Sub-grade	500 mm	
1.13	**Basic Lead of Material**		

Sl.	Particular	Proposed Normative costs Norms	Remarks
(i)	Aggregate	50 Km.	Aggregate Lead has been considered 50 Km. for base Cost, it may vary in the proposed Project Cost Analysis Tool.
(ii)	Bitumen	0 to 300 Km.	
(iii)	Earth	5 Km.	Lead from borrow to site is considered 5 Km.
(iv)	Project Lead	13 Km.	Project Length has been considered 50 Km.

5.3 The Finishing Road Level (FRL) of the crossing road under the VUP/ PUP/ Flyover shall be atleast 150 mm above the FRL of the slip road/ crossing road.

5.4 The proposed Normative Cost Norms are excluding the provision of various miscellaneous items such as Toll Plaza, Rest Area, Bus bays, Truck lay-byes, ATMS, Foot over bridge, Road & Traffic signage, Wayside amenities, ambulance, crane and other project facilities. Cost of these items is to be worked out as per site requirement in each case or lump-sum provision @ 10% to 15% of Total Project Cost (excluding LA) may be considered to arrive at the normative cost for these additional items.

5.5 The centages involved depending on the mode of execution of the work i.e. EPC, BOT and Hybrid Annuity, are notified by the Ministry of Road Transport & Highways from time to time and the costs of these centages may be added to the normative civil costs to arrive at the Total Project Cost based on Normative Cost Norms.

5.6 The normative costs derived on the basis of above Project Cost Tool is only to be used for comparison during Appraisal and Approval of the projects and not be used for preparation of estimates for project highways.

6. This issues with concurrence of Finance Wing vide their U.O. No. vide note #11 dated 26.10.2021 and approval of Minister (RT&H).

7. Contents of this circular may be brought to the notice of all the concerned for immediate compliance.

Yours faithfully,

Narender 19.1.22

(Narender Sharma)
Superintending Engineer (BP &SP)

Encl :

1. Interactive Microsoft Excel based Project Cost Analysis Tool for Plain & Rolling Terrain.
2. User manual.

Copy to :

1. All Technical Officers at the Headquarters
2. Secretary General, Indian Roads Congress
3. Director, IAHE, NOIDA
4. All ROs, MoRT&H.
5. Sr. PPS to Secretary (RT&H), Sr. PPS to DG (RD) & SS, PS to AS&FA, PS to ADG-I/II/III.
6. NIC-with the request to upload on the Ministry's portal.

Copy for information to:

1. CEO, NITI Aayog, NITI Bhawan, Sansad Marg, New Delhi.
2. Secretary, Department of Expenditure, Ministry of Finance, North Block, New Delhi.
3. Secretary, Department of Economic Affairs, Ministry of Finance, North Block, New Delhi.
4. Secretary, Ministry of Environment and Forests, Paryavaran Bhawan, New Delhi.
5. Secretary, Ministry of Development of North Eastern Region, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi.

No. RW/NH-24036/27/2010-PPP
Government of India
Ministry of Road Transport & Highways
(EAP) Zone
Transport Bhawan, 1, Parliament Street, New Delhi-110001

Dated: 25.04.2018

To

1. The Chairman, National Highways Authority of India (NHAI), G-5&6, Sector-10, Dwarka, New Delhi-110 075.
2. The Managing Director, National Highway Infrastructure Development Corporation Ltd., 3rd floor, PTI Building, Parliament Street, New Delhi-110 001
3. The Principal Secretaries/Secretaries of all States/UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes & State Schemes.
4. Director General (Border Roads), Seema Sadak Bhawan, Ring Road, New Delhi-110010
5. The Engineers-in-Chief and Chief Engineers of all States/UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes & State Schemes.

Subject: Revision of Normative Cost Norms for the National Highways - Reg.
Reference: (i) Circular No. RW/NH-24036/27/2010-PPP dated 10.08.2016.

Sir,

The issue of cost-estimates of National Highways has been coming up at various fora. Historically, a reference is made is made to the costing norms as considered by the B.K. Chaturvedi Committee in the then Planning Commission. It has been observed that the said costing norms, as adopted by the BKC Committee, were actually based on the data provided by the NHAI at that time. The same have been updated by Ministry of Road Transport & Highways from time to time.

2. The existing Normative Costs are for three categories of roads i.e. (a) 2-lane with paved shoulders, (b) 4-lane, and (c) 6-lane irrespective of the terrain i.e. plain terrain/ hilly terrain where the project road is to be developed/ constructed. The concerned project executing agencies have been presenting their proposals with justifications of road components like number of structures, additional earthwork/ cutting in hilly terrain, stabilisation of slopes, prevailing schedule of rates etc. However, the existing norms do not cover the entire gamut of activities. As a result, there is no proper format to justify the project costs.

3. Keeping in view the above factors and the need to bring some uniformity for the entire country for justification of project costs, this Ministry constituted a Committee

comprising of all stakeholders viz. NHAI, NHIDCL and the concerned project zones of the Ministry dealing with the construction of National Highways projects to prepare the Normative Cost Norms for various road components. Based on the Committee's report and various representations during discussions in the Senior Officer's Meeting chaired by Secretary (RT&H), the Normative Cost Norms have been reviewed and revised. Accordingly, the cost norms have been finalised as contained in this circular in supersession to **Circular No. RW/NH-24036/27/2010-PPP dated 10.08.2016 through which the cost norms were updated up to the Financial Year 2016-17.**

4. Assumptions:

Various assumptions have been taken in order to calculate the Normative costs for the road projects which are as follows:

4.1	**Road Portions:** The road works have been classified into 16 categories as detailed in Table-1 of this circular.	
(i)	Average Embankment height (excl. pavement crust)	1.0 m.
(a)	Designed Traffic for 2 lane with paved shoulders	40 MSA
(b)	Designed Traffic for 4 lane	80 MSA
(c)	Designed Traffic for 6 lane	100 MSA
(d)	Designed Traffic for 8 lane	100 MSA
(ii)	CBR	8%
(iii)	**Crust Composition with Flexible Pavement**	
A.	***Bituminous Concrete:***	
(a)	Up to 2-lane +Paved shoulder	40 mm
(b)	4- lane/ 6-lane/ 8-Lane	50 mm
B.	***Dense Bituminous Concrete (DBM)***	
(a)	Up to 2-lane +Paved shoulder	90 mm
(b)	4- lane/ 6-lane/ 8-Lane	115 mm
C.	*Wet Mix Macadam*	250 mm
D.	*Granular Sub-base*	200 mm
E.	*Sub-grade*	500 mm
(iv)	**Crust Composition with Rigid Pavement**	
(a)	Pavement Quality Concrete (PQC)	300 mm
(b)	Dry Lean Concrete (DLC)	150 mm
(c)	Granular Sub-Base	150 mm
(d)	Sub-grade	500 mm
4.2	**Bridge Portions**	
(i)	Type of Foundation	Pile Foundation with Steel Liner (Depth-15 m.)
(ii)	Super Structure	Pre- Stressed Girder type
(iii)	Width of carriageway	As per relevant IRC Manual
4.3	**Pipe Culverts**	
(i)	Minimum Earth cushion	600 mm
(ii)	No. of Rows	One row
(iii)	Internal Diameter of Pipe	1200 mm
(iv)	Type of Hume Pipe	NP 4
(v)	Width of carriageway	As per relevant IRC Manual
4.4	**Box Culverts**	

(i)	Earth Cushion	300 mm
(ii)	Size of Box	One Cell of 2.0 m x 2.0 m
(iii)	Width of carriageway	As per relevant IRC Manual
4.5	**Elevated Structures like Flyovers/ VUPs/ PUPs**	
4.5.1	***Flyover/ VUP (Standard)***	
(i)	Type of Foundation	Pile Foundation with Steel Liner (Depth-15 m.)
(ii)	Type of Abutment/Pier	Circular (Single Pier Type)
(iii)	Vertical Clearance	5.50 m
(iv)	Span Arrangement	10m + 20 m+10 m (40 m.)
(v)	Super Structure	Pre- Stressed Girder type
(vi)	Width of carriageway	As per relevant IRC Manual
4.5.2	**VUP (Low Height) known as VUP-L**	
(i)	Type of Foundation	Pile Foundation with Steel Liner (Depth-15 m.)
(ii)	Type of Abutment/ Pier	Circular (Single Pier Type)
(iii)	Vertical Clearance	4.00 m
(iv)	Span Arrangement (with 2.5 m wide raised Pedestrian path on one side with partition railing and 0.5 mt protection on the other side)	12 m
(v)	Super Structure	Pre- Stressed Girder type
(vi)	Width of carriageway	As per relevant IRC Manual
4.5.3	**Pedestrian Underpass**	
(i)	Type of Foundation	Open Foundation (Box type)
(ii)	Box Size	6 x 2.5 mtrs.
(iii)	Vertical Clearance (Note: It has to be ensured that the finished floor level of the PUP is 6" above the adjoining ground level)	2.5 m
(iv)	Span Arrangement	6.0 m
(v)	Width of carriageway	As per relevant IRC Manual
4.5.4	**Slope Protection Works**	
(i)	***For Plain Terrain***	
(ii)	Type of Slope Protection (retaining wall)	With PCC: M-15
(iii)	Height	3.0 mtr.
(iv)	***For Hilly Terrain***	
(v)	Type of Slope Protection (retaining and/ or breast wall)	With PCC: M-15
(vi)	Height	3.0 mtr.
4.5.5	**Service/ Slip Road**	
A.	***With Flexible Pavement***	
(i)	Width of carriageway	5.5 m/ 7.5m./ 10 m.
(ii)	Designed Traffic	40 MSA
(iii)	Embankment height	1.0 m.
(iv)	CBR of soil	8%
(v)	Crust Composition	
(vi)	Bituminous Concrete	40 mm
(vii)	Dense Bituminous Macadam	90 mm
(viii)	Wet Mix Macadam	250 mm
(ix)	Granular sub-base	200 mm
(x)	Sub-grade	500 mm
B.	***With Rigid Pavement***	

(i)	Width of carriageway	5.5 m/ 7.5m./ 10 m.
(ii)	Embankment height	1.0 m.
(iii)	CBR of soil	8%
(iv)	**Crust Composition**	
(v)	PQC	300 mm
(vi)	DLC	150 mm
(vii)	Granular Sub-base	150 mm
(viii)	Sub-grade	500 mm
4.5.6	**Hill Cutting**	
(i)	15 m height of 200 m for 2 lane and full length for new construction/ 4 lane alignment	
4.5.7	**Boundary Wall**	
(i)	Boundary wall along the ROW, except at ingress and egress points, shall be constructed as per enclosed Typical cross section	

5. The proposed Normative Cost Norms are excluding the provisions of various miscellaneous items such as Toll Plaza, Road and Traffic signage, Wayside amenities, ambulance, crane and other project facilities. Cost of these items may be worked out as per site requirements in each case or lump-sum provision @ 5% of Total Project Cost (excluding the cost of these items and Land Acquisition) may be added to arrive at the normative costs.

Table- 1

Normative Cost Norms

(Amount – Rs. in Crore)

Sr. No.	Description of Works	Unit	For Embankment in Plain Terrain			For Embankment in Hilly Terrian		
			1 m.	1.50 m	2.0 m	1 m.	1.50 m	2.0 m
A.	**Flexible Pavements**							
1.	Widening to 2 Lane + Paved Shoulder	km	3.19	3.38	3.59	6.29	6.5	6.73
2.	Widening the Existing 2 Lane to 4 Lane	km	5.58	6.92	7.29	14.42	14.72	15.04
3.	Widening the Existing 4 Lane to 6 Lane	km	4.89	5.08	5.28	N.A.	N.A.	N.A.
4.	Widening the existing 4 lane to 8 lane	km.	6.59	6.84	7.11	N.A.	N.A.	N.A.
5.	Widening the existing 6 lane to 8 lane	km.	5.7	5.88	6.08	N.A.	N.A.	N.A.
6.	Greenfield Alignment -2 Lane	km	3.24	3.46	3.71	9.6	9.84	10.11
7.	Greenfield Alignment-4 Lane	km	5.84	6.18	6.55	19	20	20
8.	Greenfield Alignment- 6 Lane	km	7.75	8.17	8.61	N.A.	N.A.	N.A.
9.	Greenfield Alignment- 8 lane	km.	9.2	9.67	10.17	N.A.	N.A.	N.A.
B.	**Rigid Pavements**							
1.	Widening the Existing 4 Lane to 6 Lane	km	3.52	3.76	4.03	N.A.	N.A.	N.A.
2.	Widening the existing 4 lane to 8 lane	km.	5.29	5.6	5.92	N.A.	N.A.	N.A.

Table- 1 Normative Cost Norms (Amount – Rs. in Crore)								
Sr. No.	Description of Works	Unit	For Embankment in Plain Terrain			For Embankment in Hilly Terrian		
			1 m.	1.50 m	2.0 m	1 m.	1.50 m	2.0 m
3.	Widening the existing 6 lane to 8 lane	km.	3.13	3.37	3.62	N.A.	N.A.	N.A.
4.	Greenfield Alignment- 2 Lane + Paved Shoulder	km	4.03	4.26	4.5	N.A.	N.A.	N.A.
5.	Greenfield Alignment- 4 Lane	km	6.58	6.92	7.29	N.A.	N.A.	N.A.
6.	Greenfield Alignment- 6 Lane	km	8.87	9.26	9.65	N.A.	N.A.	N.A.
7.	Greenfield Alignment-8 Lane	km.	10.48	10.87	11.26	N.A.	N.A.	N.A.

Table: 2 Normative cost norms per running km for Roads for Hilly terrain (Rs. in Cr.)		
A	**With Flexible pavement**	
1	Widening to 2 Lane + Paved Shoulder (Flexible Pavement)	6.29
2	Widening the Existing 2 Lane to 4 Lane (Flexible Pavement)	14.42
3	Greenfield Alignment 2 Lane + Paved Shoulder (Flexible Pavement)	9.60
4	Greenfield Alignment 4 Lane (Flexible Pavement)	18.93

Table: 3		
A.	**Normative cost norms per running km for Service Roads for Plain terrain (Rs. in Cr.)**	
1	With flexible pavement (5.50 mtrs carriageway)	Rs. 1.80 cr
2	With flexible pavement (7.00 mtrs carriageway)	Rs. 2.26 cr
3	With flexible pavement (10.00 mtrs carriageway)	Rs. 2.96 cr
4	With rigid pavement (5.50 mtrs carriageway)	Rs. 2.51 cr
5	With rigid pavement (7.00 mtrs carriageway)	Rs. 3.17 cr
6	With rigid pavement (10 mtrs carriageway)	Rs. 4.03 cr
B.	**Normative cost norms per running km for Service Roads for Hilly terrain (Rs. in Cr.)**	
1.	With flexible pavement (5.50 mtrs carriageway)	Rs. 2.49 cr
2.	With rigid pavement (5.50 mtrs carriageway)	Rs. 6.08 cr

Table: 4

Normative Costs for Structures (Flyovers/ VUPs/ PUPs) (Rs. in Cr.)

Sr. No.	Description of Work	Plain Terrain				Hilly Terrain			
		Bridge Proper Cost (per sqm.)	Bridge proper Total cost	Approach (in Rs.)	Total cost (Bridge+ Approach)	Bridge Proper Cost (per sqm.)	Bridge proper Total cost	Approach (in Rs.)	Total cost (Bridge+ Approach)
1.	**Flyover/ VUP(S), Span arrangement - 10+20+10 m ; Vertical Approach - 5.50 m**								
1.1	For 2-lane+ Paved shoulders	0.003	1.70	8.48	10.18	0.004	2.37	10.14	12.51
1.2	For 4-lane carriageway	0.003	2.98	12.15	15.13	0.004	4.16	15.53	19.68
1.3	For 6-lane carriageway	0.003	3.59	13.60	17.19	0.004		N.A.	
1.4	For 8-lane carriageway	0.003	4.62	16.06	20.68	0.004		N.A.	
2.	**VUP(L), Span Arrangement – 1x12 m., Vertical Clearance - 4.0 m.**								
2.1	For 2-lane+ Paved shoulders	0.003	0.45	6.22	6.67	0.004	0.61	7.92	8.53
2.2	For 4-lane carriageway	0.003	0.79	8.55	9.33	0.004	1.07	11.41	12.48
2.3	For 6-lane carriageway	0.003	0.95	9.57	10.51	0.004		N.A.	
2.4	For 8-lane carriageway	0.003	1.22	11.30	12.52	0.004		N.A.	
3.	**Pedestrian Underpass (PUP), Span Arrangement - 2.5x6 m.**								
3.1	For 2-lane+ Paved shoulders	0.004	0.31	4.23	4.53	0.004	0.37	5.52	5.89
3.2	For 4-lane carriageway	0.004	0.53	5.72	6.25	0.004	0.65	7.84	8.49
3.3	For 6-lane carriageway	0.004	0.64	6.37	7.02	0.004		N.A.	
3.4	For 8-lane carriageway	0.004	0.83	7.48	8.31	0.004		N.A.	
	(*Costs for VUP/PUP are as per attached drawings)								

Table: 5

Normative Cost norms for / Bridges/ Protection Works Amount in Rs. Cr.

Sr. No.	Description of Works	Unit	Average cost for plain terrain	Average cost for hilly terrain
1.	Bridge Proper	Per sq. m.	0.0032	0.0082
2.	Slope Protection works			
	(a) Breast Wall			
	(i) PCC type	Per mtr.	0.0037	0.0037
	(b) Retaining wall			
	(i) PCC type	Per mtr.	0.0024	0.0024
3.	Boundary wall (PCC-1:2:4)*		0.00018	0.00018
	*Typical cross section of Boundary wall is enclosed			

6. The centages involved depending on the mode of execution of the work i.e. EPC, BOT and Hybrid Annuity, are notified by the Ministry of Road Transport & Highways from time to time and the costs of these centages may be added to the normative civil costs to arrive the total project cost based on Normative cost norms.

7. The normative costs derived on the basis of this Circular should only be used for comparison during Appraisal and Approval of the projects and should not be used for preparation of estimates. These Normative Costs shall be applicable from April 01, 2018 and until further updation as deemed necessary.

8. The Finished Road Level (FRL) of the crossing road under the VUP/ PUP/ Flyover shall be atleast 150 mm above the FRL of the slip road/ crossing road.

9. This issues with concurrence of Finance Wing vide their U.O. No. 2344 TF-II dated 03.01.2018 and approval of Minister (RT&H).

10. Contents of this circular may be brought to the notice of all the concerned for immediate compliance.

Yours faithfully,

(Khushal Chand)
Superintending Engineer (EAP)

Copy to:

1. All Technical Officers at the Headquarters
2. Secretary General, Indian Roads Congress
3. Director, IAHE, NOIDA
4. All ROs and ELOs of MoRT&H.
5. PPS to Secretary (RT&H), PPS to DG(RD) & SS, PS to AS&FA, PS to ADG –I/ II/ III/ IV/ V.
6. NIC- with the request to upload on the Ministry's portal.

Copy for information to:

1. CEO, NITI Aayog, NITI Bhawan, Sansad Marg, New Delhi.
2. Secretary, Department of Expenditure, Ministry of Finance, North Block, New Delhi.
3. Secretary, Department of Economic Affairs, Ministry of Finance, North Block, New Delhi.
4. Secretary, Ministry of Environment and Forests, Paryavaran Bhawan, New Delhi.
5. Secretary, Ministry of Development of North Eastern Region, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi.

VUP(s) / Flyover

Page 8

Use of Ultra High Performance Fiber Reinforced Concrete (UHPFRC) in Design & Construction of Structures / Bridges of National Highways

File No.RW/NH-33049/01/2020-S&R (B) Pt.
Government of India
Ministry of Road Transport & Highways
(S&R (P&B/New Technology) Zone)
Transport Bhawan, 1, Parliament Street, New Delhi-110001

Dated: 22th February, 2022

CIRCULAR

To,

1. The Chief Secretaries of all the State Governments/ UTs.
2. The Principal Secretaries/ Secretaries of all States/ UTs Public Works Department/ Road Construction Department/ Highways Department (dealing with National Highways and other centrally sponsored schemes).
3. The Chairman, National Highways Authority of India, G-5 & 6, Sector-10, Dwarka, New Delhi-110 075.
4. The Managing Director, NHIDCL, PTI Building, New Delhi-110001.
5. The Director General (Border Roads), Seema Sadak Bhawan, Ring Road, New Delhi- 110 010.
6. All Engineers-in-Chief and Chief Engineers of Public Works Department of States/ UTs/ Road Construction Department/ Highways Departments (dealing with National Highways and other centrally sponsored schemes).
7. All CE-ROs, ROs and ELOs of the Ministry.

Subject: - Use of Ultra High Performance Fiber Reinforced Concrete (UHPFRC) in Design & Construction of Structures/Bridges of National Highways - Regarding

Madam/Sir,

Advanced structural design guidelines IRC: 112-2020 "Code of Practice for Concrete Road Bridges" and analysis software are presently being used in India. These are in tune with the International codes. However, its full exploitation to design the durable cost-effective slender sections are being made in a very limited manner. Therefore, need is felt for adoption of State-of-Art advanced level of bridge technologies for use in National Highway projects so that widespread usages of more cost effective sustainable design solutions and implementation methodologies are encouraged.

2. Concrete up to M50 grade is generally being used for bridges and structures on National Highways in India. Indian Roads Congress (IRC) has published IRC: SP: 70-2016 "Guidelines for the Use of High Performance Concrete in Bridges" which provides for use of High Performance Concrete/Self-Compacted Concrete up to M90 grade. It is, however, observed that use of High Performance Concrete/Self-Compacted Concrete (M60 to M90 grade) is limited to a few long span extra dose/cable stayed bridges only.

Bidur Kant Jha

Page 1 / 3

3. Properly designed Ultra-high-performance fiber reinforced concrete (UHPFRC) which have following superior characteristics are being used in some developed countries:

- Available up to Grade M150MPa
- Available up to ultimate tensile strength 8MPa and ultimate flexural strength 30MPa.
- At least 4-6 times stronger than normal concrete (in compressive strength)
- Much more durable than conventional concrete
- Longer service life
- Reduced deck height
- Lower carbon footprint

4. Recently UHPFRC girders have been used in Sole River Bridge at Km 42+050 of NH -752K near Latur (2x56m span). Few more bridges/viaducts of span varying from 50-72m have been approved for construction. A bridge over Ganga River parallel to JP Setu in Patna is under planning that envisages use of UHPFRC girders for 100m span.

5. On careful consideration of the advantages of UHPFRC, it is found that UHPFRC girders may be preferred in long span bridges i.e. span length ranging from 50m to 100m in India. In the urban viaduct structures, where generally 30m standard span is used, span length can be increased to 60m with use of UHPFRC. It can also be used for smaller span.

6. To promote use of UHPFRC girders in bridges and structures in India, following has been decided:

6.1. While preparing detailed project report, Consultants shall evaluate both traditional PSC girders and UHPFRC girders for elevated corridors/ viaduct sections and bridges having length 500 m and above and consider the preferred alternative in cost estimate and analysis. Similar exercise shall also be done if aggregate length of bridges having span length greater than 30m and viaduct sections is greater than 2000m in a single project.

6.2. The French design standard and material specification to be referred are NF P18-710- " National addition to Euro code 2 – Design of concrete structures: specific rules for Ultra-High Performance Fibre-Reinforced Concrete (UHPFRC) & NF P18-470- "Concrete - Ultra-High Performance Fiber-Reinforced Concrete - Specifications, Performance, Production and Conformity".

6.3. Concessionaire/Contractor is free to use UHPFRC girders in its design. IE/AE shall review and approve the design without any prejudice.

6.4. Although usage of UHPFRC is expected to result in significant cost savings and reduction in life cycle costs, it is decided at this stage that the cost implications of

Bidur Kant Jha.

using the technology may be fully absorbed within the Agreement cost of the project until further orders and the Authority (i.e. executing agency) shall neither demand for any share of cost reduction benefits nor pay/compensate for additional expenses incurred by the Concessionaire / EPC Contractors as per the Ministry's policy circulated vide letter No. RW/NH-33044/18/2020-S&R (P&B) dated 14.12.2020 even if the changes are accompanied by reduction in number of foundations and piers.

6.5. Defect liability period of such bridges/structures will be 10 years irrespective of whether defect liability period of the project is 5 years.

6.6 Concessionaire/contractor shall submit a detailed bridge inspection plan on completion of the construction works to the Ministry for approval. Concessionaire/contractor, IE/AE, Authority shall jointly conduct periodic inspection of the structure and will prepare a condition monitoring report. This report shall be prepared and submitted to the Ministry on half-yearly basis till completion of the defect liability period unless otherwise decided by the Ministry.

7. It is requested that the contents of the letter may be brought into the notice of all concerned for needful compliance.

8. This issues with the approval of Competent Authority.

विदुर कान्त झा / Bidur Kant Jha
निदेशक / Director
सड़क परिवहन एवं राजमार्ग मंत्रालय
Ministry of Road Transport & Highways
भारत सरकार / Government of India
नई दिल्ली / New Delhi-110001

Yours faithfully,

Bidur Kant Jha
22-02-2022

(Bidur Kant Jha)
Director
(New Technology for Highway development)
For DG (RD) & SS

Copy to:

1. All CEs in the Ministry of Road Transport & Highways
2. All ROs of the Ministry of Road Transport & Highways
3. The Secretary General, Indian Roads Congress
4. Technical circular file of S&R (P&B) Section
5. NIC-for uploading on Ministry's website under "What's new"

Copy for information and necessary action to:

1. Sr. PPS to Secretary (RT&H)
2. PPS to DG (RD) & SS
3. Sr. PPS/ PPS to Addl. Secretary (Road Safety)/ Addl. Secretary (RT&H & LA)
4. Sr. PPS/ PPS to AS&FA
5. Sr. PPS/ PPS to ADG (SKN) / ADG (RP)/ ADG(DS)
6. Sr. PPS/ PPS to JS (RT&MVL)/ JS (EIC) / JS (Logistics)/ JS (NHIDCL)

Guidelines for Use of Ultra High Performance Fiber Reinforced Concrete (UHPFRC) in Railway Structures

File No.RDSO-BnS0ESTR(CB-1)/5/2020-O/o ED/STRUCTURES/RDSO

वी.के. पाण्डेय
V.K. Pandey
कार्यकारी निदेशक/पु०एवंसं०-II
Executive Director/B&S-II

भारत सरकार–रेल मंत्रालय
अनुसन्धान अभिकल्प और मानक संगठन
लखनऊ–226011
Government of India-Ministry of Railways
Research Designs & Standards Organisation
Lucknow- 226011
Phone/ Fax: 0522-2465704
Email: edbns2rdso@gmail.com

पत्रांक सं: CBS/PCB

दिनांक: 08.03.2024

Principal Chief Engineers:

1. Central Railway, Mumbai CST - 400001
2. Eastern Railway, Fairlie Place, Kolkata - 700001
3. East Central Railway, Hazipur - 844101
4. East Coast Railway, Bhubaneshwar - 751016
5. Northern Railway, Baroda House, New Delhi - 110001
6. North Central Railway, Allahabad - 211001
7. North Eastern Railway, Gorakhpur - 273001
8. Northeast Frontier Railway, Maligaon, Guwahati - 781061
9. North Western Railway, Jaipur - 302001
10. Southern Railway, Park Town, Chennai - 600003
11. South Central Railway, Rail Nilayam, Secunderabad - 500371
12. South East Central Railway, Bilaspur - 495004
13. South Eastern Railway, Garden Reach, Kolkata - 700043
14. South West Railway, Hubli - 580023
15. Western Railway, Mumbai - 400020
16. West Central Railway, Jabalpur - 482001
17. Metro Railway, Jawaharlal Nehru Road, Kolkata – 700071

विषय: Guidelines for use of Ultra High Performance Concrete in Railway Structures

संदर्भ: 1. Railway Board's letter No 2022/19/CE-III/BR/RDSO/1 Dated 19.10.2023.
2. RDSO letter No. CBS/PCB Dated 13.02.2024.

1. Railway Board vide Ref.1 above had entrusted Bridge & Structure Directorate, RDSO to prepare a guideline for use of Ultra High Performance Concrete in Railway Structures.
2. The draft guideline was sent to all Zonal Railways and Railway PSU's for their Feedback/comment vide Ref.2 above. Guideline have been revised based on feedback received.
3. Please find enclosed herewith the "*Guidelines for use of Ultra High Performance Concrete in Railway Structures*" as BS-136. The copy of the same is enclosed herewith for information & necessary action please.
   It may also be accessed at Railnet link
   http://10.100.2.4/drawing/frmPage.aspx?id=15

संलग्नक: As above

08/03/24

(विनय कृष्ण पांडेय)
(Vinay Krishna Pandey)
कार्यकारी निदेशक /पुल एवं संरचना-II
Executive Director/B&S-II

प्रतिलिपि:

(A)
1. Additional Member (Civil Engg.) Railway Board, Rail Bhawan, New Delhi - 110001
2. Additional Member (Works) Railway Board, Rail Bhawan, New Delhi - 110001
3. Principal Executive Director/Bridges, Railway Board, Rail Bhawan, New Delhi - 110001
4. Director General, Indian Railway Institute of Civil Engg., Pune - 411 001
5. Executive Director Civil Engg./B&S, Railway Board, Rail Bhawan, Room No.140A, New Delhi - 110001
6. General Manager (C), N. F. Railway, Maligaon, Guwahati - 781001
7. The Director General, National Academy of Indian Railways, Vadodara – 390004
8. The Vice Chairman, Rail Land Development Authority, Unit No.702-B, 7th Floor, Konnectus Tower-2, DMRC Building, Ajmeri Gate, Delhi-110002

(B) **The Chief Administrative Officer (Construction):**
1. Central Railway, Mumbai CST - 400001
2. Eastern Railway, Fairlie Place, Kolkata - 700001
3. East Central Railway, Mahendrughat, Patna (Bihar) - 800004
4. East Coast Railway, Bhubaneswar, (Orissa) - 751016
5. Northern Railway, Kashmere Gate, Delhi - 110006
6. USBRL Project, Northern Railway, Satyam Complex, Trikuta Nagar Extn., Jammu 180020
7. North Central Railway, Allahabad, (U.P.) - 211001
8. North Eastern Railway, Gorakhpur - 273001
9. North Western Railway, Jaipur, (Rajasthan) - 302001
10. Southern Railway, Egmore, Chennai – 600008
11. South Central Railway, DRM/Secunderabad Office Compound, Secunderabad -500 371
12. South Eastern Railway, Garden Reach, Kolkata – 700043
13. South East Central Railway, Bilaspur - 495004
14. South Western Railway, No. 18 Miller Road, Bangalore, (Karnataka) – 560046
15. Western Railway, Mumbai - 400020
16. West Central Railway, Jabalpur (M.P.) - 482001
17. CAO-I, II & III, Northeast Frontier Railway, Maligaon, Guwahati - 781011
18. CAO/ERS, Southern Railway, Ernakulam, Kerala – 682506

(C) **Chief Bridge Engineers:**
1. Central Railway, Mumbai CST- 400001
2. Eastern Railway, Fairlie Place, Kolkata - 700001
3. East Central Railway, Hazipur - 844101
4. East Coast Railway, Bhubaneshwar - 751016
5. Northern Railway, Baroda House, New Delhi - 110001
6. North Central Railway, Allahabad - 211001
7. North Eastern Railway, Gorakhpur - 273001
8. Northeast Frontier Railway, Maligaon, Guwahati - 781061
9. North Western Railway, Jaipur - 302001
10. Southern Railway, Park Town, Chennai - 600003
11. South Central Railway, Rail Nilayam, Secunderabad - 500371
12. South East Central Railway, Bilaspur - 495004
13. South Eastern Railway, Garden Reach, Kolkata-700043
14. South West Railway, Hubli - 580023
15. Western Railway, Mumbai - 400020
16. West Central Railway, Jabalpur - 482001
17. Metro Railway, Kolkata – 700071

(D) Commissioner of Railway Safety:

1. Chief Commissioner of Railway Safety, N.E. Railway Office Compound, Ashok Marg, Lucknow – 226002
2. Central Circle, 2nd Floor, Churchgate Station Building Mumbai - 400020
3. Eastern Circle, Multistoreyed Building of Eastern Railway, 12th Floor, Strand Road, Kolkata - 700001
4. Northern Circle, near Centre for Railway Information System, Safdarjung Railway Station, New Delhi - 110021
5. North Eastern Circle, DRM Compound, Northern Railway, Hazratganj, Lucknow - 226001
6. Northeast Frontier Circle, 12 Strand Road, Multistoryed Building of Eastern Railway, Kolkata - 700001
7. Southern Circle, 7 Seshadri Road, Gandhi Nagar, Bangalore - 560009
8. South Central Circle, Opp. Rail Nilayam, Sarojini Devi Road, Secunderabad - 500071
9. South Eastern Circle, 14 Strand Road, Multistoryed Building of Eastern Railway, Kolkata-700001
10. Western Circle, 2nd Floor, Churchgate Station Building Annexe, Maharishi Karve Road, Mumbai-400020.

(E) Railway PSUs & Others:

1. The Managing Director, RITES LTD, RITES Bhawan, Plot No.1, Sect.29, Gurgaon (Haryana) - 122001
2. The Managing Director, IRCON, Palika Bhawan, Sector-XIII, R.K. Puram, New Delhi - 110066
3. The Chairman & Managing Director, Konkan Railway Corporation Ltd., Belapur Bhavan, Plot No. 6, Sector-II CBD Belapur, Navi Mumbai - 400614
4. The Managing Director, Rail Vikas Nigam Ltd., Ist floor, August Kranti Bhawan, Bhikaji Coma Place, Africa Road, R.K. Puram, New Delhi - 110016
5. The Managing Director, DFCCIL, 5th Floor, Pragati Maidan, Metro Station Building Complex New Delhi - 110001
6. The Managing Director, Delhi Metro Rail Corporation Ltd., NBCC Place, Bhishma Pitamah Marg, Pragati Vihar, New Delhi – 110003

Copy of Guideline Value

ಕರ್ನಾಟಕ ರಾಜ್ಯ ರಾಜಪತ್ರ

ಅಧಿಕೃತವಾಗಿ ಪ್ರಕಟಿಸಲಾದುದು

ಬೆಂಗಳೂರು ಶನಿವಾರ, ಸೆಪ್ಟೆಂಬರ್ 23, 2023(ಭಾದ್ರಪದ 01, ಶಾಸನ ಸಂ. 1945)

BENGALURU, SATURDAY, 23, SEPTEMBER, 2023(BHADRAPADA 01, SHAKAVARSHA, 1945)

ಭಾಗ - 4 Part – III	ಸಂ.438 No. 438

ನೋಂದಣಿ ಮತ್ತು ಮುದ್ರಾಂಕ ಇಲಾಖೆ

ಅಧಿಸೂಚನೆ

ಸಂಖ್ಯೆ: ನೋಇಮು/ಸಿಂವಿಸಿ/99/2023-24, ಬೆಂಗಳೂರು, ದಿನಾಂಕ: 27-09-2023.

ವಿಷಯ: ಬೆಂಗಳೂರು ನಗರ ಜಿಲ್ಲೆಯ ಜಯನಗರ ಜಿಲ್ಲಾ ನೋಂದಣಿ ಕಛೇರಿ ವ್ಯಾಪ್ತಿಯ ಸ್ವತ್ತಿಗೆ ಸಂಬಂಧಿಸಿದಂತೆ ಮಾರುಕಟ್ಟೆ ಮೌಲ್ಯ ನಿಗದಿಪಡಿಸಿರುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: 1. ಅಧಿಸೂಚನೆ ಸಂಖ್ಯೆ: ನೋಇ.ಮು/ಸಿಂವಿಸಿ/99/2023-24, ದಿನಾಂಕ 08-09-2023

2. ಕೇಂದ್ರ ಮೌಲ್ಯ ಮಾಪನ ಸಮಿತಿ ಸಭೆಯ ನಡವಳಿ ಸಂಖ್ಯೆ: ನೋಇ(ಮು)/ಸಿಂವಿಸಿ/99/2023-24, ದಿನಾಂಕ: 27-09-2023.

*****

1. ಬೆಂಗಳೂರು ನಗರ ಜಿಲ್ಲೆಯ ಜಯನಗರ ಜಿಲ್ಲಾ ನೋಂದಣಿ ಕಛೇರಿಯ ವ್ಯಾಪ್ತಿಯ ಸ್ವತ್ತಿಗೆ ಸಂಬಂಧಿಸಿದಂತೆ ಮಾರುಕಟ್ಟೆ ಮೌಲ್ಯ ನಿಗದಿಪಡಿಸಿ ಹೊರಡಿಸಿರುವ ಅಧಿಸೂಚನೆಯಲ್ಲಿ ಉಲ್ಲೇಖ (1)ರ ಅಧಿಸೂಚನೆಯಲ್ಲಿ ನಮೂದಿಸಿರುವಂತೆ ಆಕ್ಷೇಪಣೆ/ಸಲಹೆ/ಸೂಚನೆಗಳಿಗಾಗಿ ಕಾರ್ಯದರ್ಶಿ, ಜಿಲ್ಲಾ ಪಂಚಾಯತ್, ವಿಕ್ಟೋರಿಯಾ ರಸ್ತೆ, ಬೆಂಗಳೂರು ಇವರಿಗೆ ಪ್ರಕಟಣೆ ಪ್ರಕಟವಾದ ದಿನಾಂಕ: 08-09-2023 ರಿಂದ 15 ದಿನಗಳೊಳಗಾಗಿ ಆಕ್ಷೇಪಣೆ/ಸಲಹೆ/ಸೂಚನೆಗಳನ್ನು ಸಲ್ಲಿಸುವಂತೆ ಪ್ರಚಾರಪಡಿಸಿತ್ತು.

2. ಸದರಿ ರಾಜ್ಯ ಪತ್ರಿಕೆಯು ಸಾರ್ವಜನಿಕರಿಗೆ ಲಭ್ಯವಾಗಿರುವುದರಿಂದ ಸಲಹೆ, ಆಕ್ಷೇಪಣೆಗಳನ್ನು ಕೆಳಕಂಡ ಅಧಿಕಾರಿಗಳಿಗೆ 27-09-2023 ರಂದು ನಡೆದ ಕೇಂದ್ರ ಮೌಲ್ಯ ಮಾಪನ ಸಮಿತಿಯ ಸಭೆಯಲ್ಲಿ ಸಾರ್ವಜನಿಕರಿಂದ ಸ್ವೀಕೃತವಾದ ಆಕ್ಷೇಪಣೆ/ಸಲಹೆ/ಸೂಚನೆಗಳನ್ನು ಪರಿಶೀಲಿಸಿ ಅಂತಿಮಗೊಳಿಸಲಾಗಿದೆ.

(C)

86	ವೆಸ್ಟ್ ಪಾರ್ಕ್ (ಶಾಪುರ್ಜಿ ಪಲೋಂಜಿ) Olive/Mulberry	Park West(Sharpooji Pallonji) Olive/Mulberry		79000
87	ಪಾರ್ಕ್ ವೆಸ್ಟ್ (ಶಾಪುರ್ಜಿ ಪಲೋಂಜಿ) Emerald	Park West (Sharpooji Pallonji) Emerald		79000
88	ಪಾರ್ಕ್ ವೆಸ್ಟ್ (ಶಾಪುರ್ಜಿ ಪಲೋಂಜಿ) Sapphire,Maple, Mangolia, Mahogany	Park West (Sharpooji Pallonji)Sapphire,Maple, Mangolia, Mahogany		86000
89	ಬಿನ್ನಿಮಿಲ್ ಸರ್ಕಲ್ ನಿಂದ ಮೈಸೂರು ಸರ್ಕಲ್ ವರೆಗೆ	From Binnymill circle to Mysore Circle	90000	
90	ಇ.ಟಿ.ಎ. ಡೆವಲಪರ್ಸ್ ಅಪಾರ್ಟ್‌ಮೆಂಟ್	E.T.A Developers Apartment		75000
91	ಪಾದರಾಯನಪುರ ಪೈಪ್ ಲೈನ್	Padarayanapura Pipe Line	70000	
	ಗುಡ್ಡದಹಳ್ಳಿ Ward No. 133	**Guddadahalli Ward No. 133**		
92	ಹೊಸಗುಡ್ಡದಹಳ್ಳಿ ಮುಖ್ಯ ರಸ್ತೆಗಳು	Hosaguddadahalli Main Roads	42000	
93	ಹೊಸಗುಡ್ಡದಹಳ್ಳಿ ಅಡ್ಡ ರಸ್ತೆಗಳು	Hosaguddadahalli Cross Roads	38000	
94	ಹಳೆಗುಡ್ಡದಹಳ್ಳಿ ಮುಖ್ಯ ರಸ್ತೆಗಳು	Haleguddadahalli Main Roads	42000	
95	ಹಳೆಗುಡ್ಡದಹಳ್ಳಿ ಅಡ್ಡ ರಸ್ತೆಗಳು	Haleguddadahalli Cross Roads	38000	
96	ಜೈ ಭಾರತ್ ನಗರ ಸ್ಲಂ	Jai Bharath Nagar Slum	33000	
97	ಮಂಜುನಾಥನಗರ ಮುಖ್ಯ ರಸ್ತೆಗಳು	Manjunatha nagara Main Roads	43000	
98	ಮಂಜುನಾಥನಗರ ಅಡ್ಡ ರಸ್ತೆಗಳು	Manjunatha nagara Cross Roads	38000	
99	ಪೈಪ್‌ಲೈನ್ ರಸ್ತೆ (ಮೈಸೂರು ರಸ್ತೆಯಿಂದ ಬಾಪೂಜಿನಗರದವರೆಗೆ)	Pipe Line Road (From Mysore Road to Bapujinagara)	50000	
100	ಮೈಸೂರು ರಸ್ತೆಯ ಬಲಭಾಗದ ಅಡ್ಡರಸ್ತೆಗಳು **Ward No. 133**	Mysore Road Rightside Cross Roads **Ward No. 133**	70000	
101	ಮೈಸೂರು ಮುಖ್ಯರಸ್ತೆ ಹೊಂದಿಕೊಂಡಂತೆ ಗುಡ್ಡದಹಳ್ಳಿಯಿಂದ – ವಿಜಯನಗರ ಜಂಕ್ಷನ್ ವರೆಗೆ	Mysore Main Road Attached From Guddadahalli to Vijayanagar Junction	130000	
102	ವಿನಾಯಕನಗರ ಮುಖ್ಯ ರಸ್ತೆಗಳು	Vinayakanagar Main Roads	55000	
103	ವಿನಾಯಕನಗರ ಅಡ್ಡ ರಸ್ತೆಗಳು	Vinayakanagar Cross Roads	50000	
	ಕುವೆಂಪುನಗರ Ward No. 133	**Kuvempu Nagara Ward No. 133**		
104	ಕುವೆಂಪುನಗರ	Kuvempu Nagara	50000	
105	ನೆಹರು ರಸ್ತೆ	Nehru Road	75000	

106	ಕುವೆಂಪುನಗರ 1ನೇ ಮುಖ್ಯರಸ್ತೆ	Kuvempu nagara 1st Main Road	75000	
107	ಕುವೆಂಪುನಗರ ಎ ಸ್ಟ್ರೀಟ್ ಯಿಂದ ಹೆಚ್ ಸ್ಟ್ರೀಟ್‌ವರೆಗೆ	Kuvempu Nagara From A Street to H Street	60000	
108	ಶಾಮಣ್ಣ ಗಾರ್ಡನ್ (ಶಾಮಣ್ಣ ನಗರ)	Shamanna Garden (Shamanna Nagara)	35000	
109	ಶಾಮಣ್ಣ ಗಾರ್ಡನ್ ಒಳ ಚರಂಡಿ ರಸ್ತೆ	Shamanna Garden Drainage Road	35000	
110	ದೇವರಾಜು ಅರಸು ನಗರ ಮುಖ್ಯರಸ್ತೆಗಳು	Devaraju Urs Road Main Roads	40000	
111	ದೇವರಾಜು ಅರಸು ನಗರ ಅಡ್ಡರಸ್ತೆಗಳು	Devaraju Urs Road CrossRoads	35000	
112	ಹೆಚ್.ಬಿ.ಜಿ. ಬಡಾವಣೆ	H.B.G Layout	40000	
113	ಪಾದರಾಯನಪುರ ಮೈಸೂರು ಮುಖ್ಯರಸ್ತೆಗೆ ಹೊಂದಿಕೊಂಡಂತೆ **Ward No. 122**	Padarayanapura Attached to Mysore Main Road **Ward No. 122**	130000	
114	ಪಾದರಾಯನಪುರ ಮುಖ್ಯರಸ್ತೆಗಳು	Padarayanapura Main Roads	50000	
115	ಪಾದರಾಯನಪುರ ಅಡ್ಡರಸ್ತೆಗಳು	Padarayanapura Cross Roads	40000	
116	ಹೊಸಹಳ್ಳಿ ಮುಖ್ಯ ರಸ್ತೆಗಳು	Hosahalli Main Roads	60000	
117	ವಿ2 ವೈಶಾಕ್ (ಅಪಾರ್ಟ್‌ಮೆಂಟ್)	V2 Vaishak (Apartment)	53000	
	ಬಾಪೂಜಿನಗರ	**Bapujinagara**		
118	ಬಾಪೂಜಿನಗರ ಮುಖ್ಯರಸ್ತೆಗಳು **Ward No. 134**	Bapujinagara Main Roads **Ward No. 134**	50000	
119	ಬಾಪೂಜಿನಗರ ಎಲ್ಲಾ ಅಡ್ಡರಸ್ತೆಗಳು	Bapujinagara All Cross Roads	40000	
120	ಕವಿಕಾ ಬಡಾವಣೆ **Ward No. 133**	Kavika Layout **Ward No. 133**	60000	
121	ಮಾರುತಿನಗರ	Maruthinagar	35000	
122	ಅನಂತ ನಗರ	Anantha Nagar	35000	
	ಗೋರಿಪಾಳ್ಯ	**Goripalya**		
123	ಗೋರಿಪಾಳ್ಯ ಮೈಸೂರು ಮುಖ್ಯರಸ್ತೆಗೆ ಹೊಂದಿಕೊಂಡಂತೆ	Goripalya Attached to Mysore Main Road	130000	
124	ಗೋರಿಪಾಳ್ಯ ಮುಖ್ಯರಸ್ತೆ **Ward No. 135**	Goripalya Main Road **Ward No. 135**	55000	
125	ಗೋರಿಪಾಳ್ಯ ಅಡ್ಡರಸ್ತೆ	Goripalya Cross Road	45000	
126	ಜಗಜೀವನರಾಮನಗರ ಮುಖ್ಯರಸ್ತೆ	Jagajeevanaramanagara Main Road	50000	

Maintenance charges for stand-alone projects like Bridge/ Tunnel /flyover works: the contractor shall be paid @ 0.25% of the Contract Price each for the first five years and @ 0.50% of the Contract Price each for the remaining period of five years. on total of items as per MORTH Ltr No.RW/NH-37010/4/2010-EAP(Printing) Vol.-IV Government of India Ministry of Road Transport & Highways Dated: 05.03.2019 AT Model agreement page 76 under section 14.1 d

No.RW/NH-37010/4/2010-EAP(Printing) Vol.-IV
Government of India
Ministry of Road Transport & Highways
(EAP Section)
Transport Bhawan, 1, Parliament Street, New Delhi - 110001

Dated: 05.03.2019

To,

1. The Principal Secretaries/Secretaries of all States/UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes & State Schemes.
2. The Engineers-in-Chief and Chief Engineers of all States/UTs Public Works Department dealing with National Highways, other Centrally Sponsored Schemes & State Schemes.
3. The Chairman, National Highways Authority of India (NHAI), G-5&6, Sector-It), Dwarka, New Delhi-110 075.
4. The Managing Director, National Highway Infrastructure Development Corporation Ltd.,3rd floor, PTI Building, Parliament Street, New Delhi- 110 001

Sub: Standard EPC Agreement for National Highways and Centrally Sponsored road works proposed to be implemented on Engineering Procurement and Construction (EPC) mode of Contract.

Ref: Ministry's letter no. RW/NH-37010/4/2010/PIC-EAP (Printing) dated 28.11.2018.

Sir,

This is in supersession to Ministry's circular referred above. Standard EPC Agreement document incorporating the various amendments made from time to time is enclosed herewith.

2. This Standard EPC Agreement shall be used for all the National Highways and centrally sponsored road works proposed to be implemented on EPC Mode of Contract for which the bids will be invited in future from the date of issue of this circular.

3. This document is available on Ministry's Web Portal(www.morth.nic.in).

4. Contents of this circular may be brought to the notice of all the concerned for immediate compliance.

5. This issues with approval of Competent Authority

Yours faithfully,

(Khushal Chand)
Chief Engineer (EAP)

Encl: As above

Copy to:

1. All Technical Officers at the Headquarters
2. Secretary General, Indian Roads Congress
3. Director, IAHE, NOIDA
4. All CE-ROs/SE-ROs of MoRT&H.

Copy for information to:

1. PPS to Secretary (RT&H), PPS to DG(RD) & SS, PPS to AS&FA, PPS to AS, PPS to JS(H), PS to ADG I/II.
2. NIC- with the request to upload on the Ministry's portal

Article 14

Maintenance

14.1 Maintenance obligations of the Contractor

(i) The Contractor shall maintain the Project Highway for a period of [5 (five) / 10 (ten)] years, corresponding to the Defects Liability Period, commencing from the date of the Completion Certificate (the "**Maintenance Period**"). For the performance of its Maintenance obligations, the Contractor shall be paid:

(a) For flexible pavement with 5 years Maintenance Period including structures: no maintenance charges shall be paid for the first year; 0.50%of the Contract Price each for the second, third and fourth year; and 1% of the Contract Price for the fifth year

(b) For rigid pavement with 10 years Maintenance Period including structures: 0.25% of the Contract Price each for the first, second and third year, 0.5% of the Contract Price each for fourth, fifth, sixth and seventh year, and 0.75% of the Contract Price each for eighth, ninth and tenth year.

(c) For flexible perpetual pavement with 10 years maintenance period including structures: no maintenance charges shall be paid for the first year; 0.5% of the Contract Price each for the second, third and fourth year; 0.75% of the Contract Price each for the subsequent years till laying of the renewal layer or end of maintenance period, whichever is earlier. The requirement for the renewal layer shall be worked out based on the survey and investigation of the existing pavement and the cost of such renewal works shall be made separately to the Contractor based on the principles defined under clause 13.2(iii). After laying of the renewal layer, the Contractor shall be paid @ 0.5% of the original Contract Price each for the remaining years till the end of maintenance period.

(d) For stand-alone Bridge/ Tunnel works: the contractor shall be paid @ 0.25% of the Contract Price each for the first five years and @ 0.50% of the Contract Price each for the remaining period of five years.

Above amount for the performance of Contractors' Maintenance obligations shall be, inclusive of all taxes. The amount payable for maintenance shall be adjusted to reflect any increase or decrease arising out of variation in WPI to be determined in accordance with the provisions of Clause 19.12. It is further agreed that the Contract Price hereunder shall be reckoned with reference to the amount specified in Clause 19.1 (i), which shall be adjusted to the extent of Change of Scope and the works withdrawn under the provisions of Clause 8.3 (iii), but shall not include any price adjustments in pursuance of Clause 19.10.

सत्यमेव जयते

CPWD

केंद्रीय लोक निर्माण विभाग

Central Public Works Department

कुर्सी क्षेत्र दरें

PLINTH AREA RATES (PAR)

2025

MPs' FLATS, BKS MARG

PLINTH AREA RATES

as on 01.04.2025

Rate in ₹ per sqm

S. No.	Description	Non-Residential Buildings			Residential Buildings	
		Offices/ Colleges	Hospitals	Schools	Hostels	Quarters
1.0	**BUILDING COST (Specifications as per Annexure-I)**					
1.1	**RCC FRAMED STRUCTURE (Upto six storeys)**					
1.1.1	Floor height 3.60 metre	30,920	31,990	23,530	-	
1.1.2	Floor height 3.00 metre	-	-	-	24,410	
1.2	**COMPOSITE (PARTIALLY LOAD BEARING AND PARTIALLY RCC FRAMED) STRUCTURE (Upto six storeys)**					
1.2.1	Floor height 3.60 metre	26,280	27,190	20,000		
1.2.2	Floor height 3.00 metre	-	-		20,750	
1.3	**EXTRA FOR**					
1.3.1	Set of six additional storey (i.e. from 7th to 12th storey)	123				
	Similarly, extra for next set of six storeys may be increased by Rs. 123/- per sqm (viz Rs. 246/- per sqm for 13th to 18th storey, Rs. 369/- per sqm for 19th to 24th storey, Rs 492/- per sqm for 25th to 30th storey and so on). The applicable plinth area shall be the sum of plinth area of all the storeys within the set of six storeys. If the next set of storeys is having fewer than six storeys, the same procedure shall be followed. For example, if building is having 15 storeys, the additional rate applicable shall be (i) Rs 123/- per sqm for sum of plinth area between 7th to 12th storey and (ii) Rs. 246/- per sqm for sum of plinth area of 13th to 15th floor.					
1.3.2	Every 0.3 metre or part thereof, additional / less height of floor above normal floor height of 3.60 metre / 3.00 metre (on areas having additional / less height)	434				
1.3.3	Every 0.3 metre or part thereof, higher plinth height over normal plinth height of 0.60 metre (on ground floor area only).	470				
1.3.4	Every 0.30 metre or part thereof, deeper foundations over normal depth of 1.20 metre (on ground floor area only).	205				
1.3.5	Making stronger foundations to take load of one additional floor at a later date (on ground floor area only).	For RCC framed structures			Composite structure	
		1800			700	
1.3.6	RCC raft foundation (on ground floor area only)	12,765				
1.3.7	Pile foundation upto a depth of 15 metre (on ground floor area only)	22,240				

Recommendations of DULT post the review meeting of B-SMILE, DULT and Design Consultants held on 31.01.2026 & 01.02.2026 under the chairpersonship of Engineer-in-Chief, GBA and Technical Director, B-SMILE regarding the proposed elevated corridors in Bengaluru.

Background:

The Directorate of Urban Land Transport has submitted its observations to the Government in UDD regarding the elevated corridor designs prepared by B-SMILE to de-congest Bengaluru roads. As per the directions of the ACS, UDD a joint review of the elevated corridor proposals and observations made by DULT on the same was held between DULT, B-SMILE and the design consultants concerned of B-SMILE on 31.01.2026 & 01.02.2026.

Recommendations of DULT based on this review are as follows:

A. Proposals for the decongesting Kanakapura Road.

S.N	Proposed Elevated Corridor	Recommendations from the review
1.	From Marenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalaghattapura NICE road via pipeline road	Proposal may be agreed to as this would add additional capacity without impacting existing Kanakapura Road subject to incorporating the following: • A direct ramp from NICE road (coming from Tumkur Road) to the proposed elevated Kanakapura Road is provisioned. • A direct ramp from the proposed elevated Kanakapura Road to NICE road (towards Tumkur Road) is provisioned. • At the elevated rotary on pipeline road and ORR, an elevated 4-lane arm must be extended till Kanakapura Road and land towards JP Nagar 6th phase. Alignment of this must be coordinated with BMRCL to avoid any conflict with Phase 3 metro alignment. • Emergency bays must be provided on elevated road every 2-3 km to facilitate clearing of stalled vehicles, parking of emergency response/ enforcement vehicles, if necessary. Project cost may be revised accordingly.
2.	Flyover at Konankunte cross for through traffic from kanakapura to banashakakri. from Khodays to konankunte metro station towards kanakapura.	It was clarified that the flyover down ramp towards Banashankari would go beyond Vasanthapur main road and land is proposed to be acquired to provide adequate space for ramp and at-grade lanes. The proposal may be agreed to subject to incorporating the following modifications: • 6m clear space is provisioned between the existing station and flyover ramp for fire access to metro

		station. This may require shifting of the alignment of the proposed flyover ramp (and columns) away from the metro station. Additional land acquisition would be required adjacent to metro station service road towards Vasanthapura side. • The flyover down ramp towards Banashankari ends at 840.00 chainage. To allow for smooth merging of traffic a 3 lane at-grade configuration shall be maintained till the end of Metro Cash and Carry (Bikaspura Road). An unobstructed foothpath of not less than 2m shall be provided all along the road on both sides, as Kanakapura Road is also HDC with high pedestrian footfall.
3.	Adayar Ananda Bhavan Raghuvanahalli Cross, Kanakapura Road 	Currently, this proposal is not a priority as a grade-separator would not be warranted for the projected traffic till next 5 years. Secondly, significant traffic is expected to get diverted to the elevated corridor proposed to be constructed parallel to Kanakapura Road along pipeline. Also, as there are many bottlenecks all along the Kanakapura road, this isolated flyover will not have much impact on de-congesting Kanakapura Road. Moreover, the design proposes a vertical clearance of 4.5m (instead of the IRC specified minimum clearance of 5.5m) due to site constraints. Hence, this proposal may be dropped at present. Alternatively, short-term junction and corridor improvements like provision of proper turning bays at junctions, closure of frequent central median openings, provision of tear-drop u-turns (by acquiring small strip of lands at strategic locations) would be more impactful in de-congesting Kanakapura road. B-SMILE may consider the same.

B. Proposals for the decongesting Mysuru Road.

S.N	Proposed Elevated Corridor	Recommendations from the review
4.	Mysuru Road from Sirsi Circle to Nayandahalli.	Proposal is agreed to be taken up by incorporating the following: • At all locations, the following configuration for the entry and exit ramps shall be followed: – All entry and exit ramps shall be of 1 lane of 4.5 to 5.5m width. – Wherever the entry ramp/ exit ramp merges/diverges from the main elevated lanes, a minimum tapering distance of 200m shall be

		provided to facilitate smooth merging/ diverging of vehicles. • The tapering provided for traffic diverging from the existing BGS flyover to the proposed elevated road (towards Nayandahalli) shall be smooth with a tapering length of atleast 200m. So that motorists need not significantly reduce their vehicle speed for diverting to the proposed elevated road. • Inbound lanes (towards KR Market) – 2 lanes should connect to the existing BGS Flyover, so that vehicles going towards KR Market can continue at the elevated level, without the need to merge with the at-grade traffic. Only 1 exit lane shall be provided before the Sirsi Circle for commuters heading towards Binny mill or TR Mills. • Proposed up-ramp from Nice Road (at Gali Anjaneya junction) shall be removed as the traffic from this up-ramp moving towards KR Market will need to cut across 3 lanes of straight traffic going towards Nayandahalli at the proposed elevated round about, which can lead to congestion on the elevated road. • Emergency bays adjacent to the travel lanes may be provisioned on the elevated roads, preferably at 2-3 km spacing (and where RoW is available) to facilitate emergency stoppage of vehicles or shifting of stall vehicles, parking of towing/ enforcement vehicles etc. • At the at-grade level, a minimum unobstructed footpath width of 2m – 2.5m shall be provided on either side of the road (without obstruction of columns utilities or other objects) to facilitate safe and convenient walking environment for pedestrians. Footpath shall be continuous, smooth, and not higher than 0.15m from road level and with access ramps to ensure footpaths are universally accessible to people of all abilities. • As Mysuru Road has high frequency of bus movement at-grade, provision for bus priority lane should be provisioned, wherever 3 lanes are available at-grade. At all bus stops along the roads,

		proper bus shelters, signage, lighting shall be provisioned. • At junctions at-grade, the columns of the elevated road shall be so designed and located that the capacity the junctions for all directional movements, queue holding capacity, adequate safe sight distance and pedestrian crossings are not compromised. The concessionaire or contractor shall ensure the same while preparing detailed designs and construction. • Costing necessary for at-grade improvement shall be included in the overall project cost. Subject to incorporating the above, approval may be accorded for taking up implementation of this corridor.

C. Proposals for the alternate connectivity between West of Chord Road & ORR (West loop)

S.N	Proposed Elevated Corridor	Recommendations from the review
5.	Elevated corridor from west of chord road to outer ring road via pipeline road.	Proposal may be agreed to as it provides alternative connectivity between ORR and West of Chord Road subject to following: • The proposed corridor is connected all the way close to the ORR, without obstructing Vrishabavathi river feed. • Land use on both sides of the pipeline is residential in nature. Hence, measures to reduce traffic noise/ dust shall be implemented to minimize impact on residents. • Provision of walking track and cycle lanes should be considered underneath the elevated road and minimize impact on trees as greening measure and as a measure to improve first-mile /last-mile connectivity by walk/ cycling to Mahalakshmi metro station and to the upcoming phase 3 metro station on ORR. Project cost may be revised accordingly.
6.	Split Flyover at MEI Junction on Tumkur Road	Proposal may be agreed to. However, as the impact of the proposal on de-congesting Tumkur Road near Yeshwanthpura stretch would not be significant, and currently signal at this junction does not induce much delays, project may be prioritized as deemed suitable by GBA.

D. Proposals for decongesting central areas and strengthening connectivity to South/South-east Bengaluru.

S.N	Proposed Elevated Corridor	Recommendations from the review
7.	Minerva circle to Hudson circle	The proposal has a few constraints that would require further consultations/ consideration: • The JC Road from Minerva Junction to Town Hall junction is being newly reconstructed as white topped road with TenderSURE standard footpath etc. The work is now near completion after significant time. Taking up elevated road on JC road would require cutting of white topped road, damage to footpaths etc. and much prolonged disturbance to traffic and businesses on JC road. • JC road has 5 lane one-way directional movement, and hence there is no capacity constraint. • Townhall is a heritage structure, and the proposed elevated road would obstruct the view and skyline of this monument impacting its aesthetics. Hence, wider consultation with heritage experts and civil society must be carried out before taking up this proposal. • Central areas of Bengaluru already have high density of roads, unlike peripheral areas and are also well connected by metro and bus services. In view of the above, proposal may be re-considered for taking up in the later phases, if need be, after due consultations.
8.	Shoolay circle to St Jhons hospital junction along Hosur road.	The proposal indicates flyover at Richmond circle and again an elevated corridor from Adugodi to St. Johns. However, currently the most critical/ congested sections between Richmond Circle and Annepalya (having only 1 lane at-grade) has no proposal for elevated corridor, ease traffic movement in the narrow section. Hence, the proposal is not impactful in resolving congestion issues on Hosur Road. An alternative comprehensive proposal to decongest Hosur road, especially between Richmond Circle and Adugodi must be proposed.

E. Proposals for East-West connectivity

S.N	Proposed Elevated Corridor	Recommendations from the review
9.	Yeshwanthpura (Mathikere cross) – IISC – Mekhri circle Jayamahal – St. John church road – Ulsoor lake – Old Madras Road – KR Puram	Proposal is agreed to be taken up by incorporating the following: • The spacing between the elevated road ramps (up and down ramp) and the existing Yeshwanthpur Flyover ramps should be of atleast 250m to allow for smooth weaving of vehicles. • Service road adjacent to the up and down ramps of the elevated road (at Yeshwanthpur) should be of 7m carriageway width with atleast 2m wide footpath. If this configuration is not feasible due to land acquisition and trees, alternatively, the up and down ramp of elevated road can be of 5.5m width each and service road carriageway can be of 5.5m with 1.5m to 2m footpath on both sides to minimize land acquisition at IISc (institute of national importance) and minimize tree cutting. • Emergency bays adjacent to the travel lanes may be provisioned on the elevated roads, preferably at 2-3 km spacing (and where RoW is available) to facilitate emergency stoppage of vehicles or shifting of stall vehicles, parking of towing/ enforcement vehicles etc. • At the at-grade level, a minimum unobstructed footpath width of 2m – 2.5m shall be provided on either side of the road (without obstruction of columns utilities or other objects) to facilitate safe and convenient walking environment for pedestrians. Footpath shall be continuous, smooth, and not higher than 0.15m from road level and with access ramps to ensure footpaths are universally accessible to people of all abilities. • At all bus stops along the roads, proper bus shelters, signage, lighting shall be provisioned. • At junctions at-grade, the columns of the elevated road shall be so designed and located that the capacity the junctions for all directional movements, queue holding capacity, adequate safe sight distance and pedestrian crossings are not compromised. The concessionaire or contractor

		shall ensure the same while preparing detailed designs and construction. • Costing necessary for at-grade improvement shall be included in the overall project cost.
10.	From Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur Road via Indira Nagar-Domlur-Madiwala	Proposal is agreed to be taken up by incorporating the following: • At all locations, only 1 lane entry ramp shall be provided and wherever the entry ramp/ exit ramp merges/diverges from the main elevated lanes, a minimum tapering distance of 200m shall be provided to facilitate smooth merging/ diverging of vehicles. • The 2-lane elevated road alignment has sharp turning radius at CMH signal (80ft Rd & CMH Road) and Junction of CMH Road and 100 ft Rd., which may be unsafe. The road width at turnings should be widened (about 4.5m may be provisioned) for larger vehicles to turn; appropriate superelevation should be provided; on the approach to these curves, rumble strips to be installed to slow/alert motorists to slow down. • As the proposed elevated road on 100ft road approaches Domlur flyover, the elevated road columns should be in the central median to avoid encroachment to footpath or road. Efforts shall be made while finalizing designs and during construction to minimize impact on existing trees on 100 ft road. • It is proposed to provide a single lane exit ramp prior to Domlur Flyover to facilitate traffic from Indiranagar side to exit towards HAL Airport. • The elevated road coming from the elevated rotary to 100 ft Road Koramangala, should directly merge with the under construction Ejipura Flyover, this would require modification/ removal of the under construction Ejipura ramp on 100 ft Rd. Koramangala. • Emergency bays adjacent to the travel lanes may be provisioned on the elevated roads, preferably at 2-3 km spacing (and where RoW is available) to facilitate emergency stoppage of vehicles or shifting of stall

		vehicles, parking of towing/ enforcement vehicles etc. • At the at-grade level, a minimum unobstructed footpath width of 2m – 2.5m shall be provided on either side of the road (without obstruction of columns utilities or other objects) to facilitate safe and convenient walking environment for pedestrians. Footpath shall be continuous, smooth, and not higher than 0.15m from road level and with access ramps to ensure footpaths are universally accessible to people of all abilities. • At all bus stops along the roads, proper bus shelters, signage, lighting shall be provisioned. • At junctions at-grade, the columns of the elevated road shall be so designed and located that the capacity the junctions for all directional movements, queue holding capacity, adequate safe sight distance and pedestrian crossings are not compromised. The concessionaire or contractor shall ensure the same while preparing detailed designs and construction. • Costing necessary for at-grade improvement shall be included in the overall project cost.

F. Proposals for improving connectivity to Airport (BIAL) and north Bengaluru.

S.N	Proposed Elevated Corridor	Recommendations from the review
11.	Ulsoor Junction to Bagalur Junction	Proposal may be agreed to as it improves road network connectivity to key SEZs like Aerospace Park, alternate connection to KIA (especially for east and north-east localities in Bengaluru) and thereby reducing traffic loading at Hebbal junction. This corridor should be extended till BIAL. Hence, development of this corridor has strategic importance.
12.	Elevated corridor from Nagavara Junction – Ramakrishna Hegde Nagar Junction – Sampige Halli – Tirumenahalli – Bella Halli	Proposal may be agreed to as it provides alternate connectivity to airport and could reduce load at Hebbal junction.

	Junction– Bagalur Main road	
13.	Grade Separator at Kempegowda Circle Old Yelahanka	Proposal may be agreed to.

Summary:

Out of the 13 elevated corridor/ flyover proposals of B-SMILE to de-congest Bengaluru roads, the following 10 elevated corridors/flyovers are agreed upon for taking it up for implementation with suggested modifications/improvements:

1. Elevated corridor from Marenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalaghattapura NICE road via pipeline road.
2. Flyover at Konankunte cross for through traffic from kanakapura to banashakakri from Khodays to konankunte metro station towards kanakapura.
3. Elevated corridor on Mysuru Road from Sirsi Circle to Nayandahalli.
4. Elevated corridor from west of chord road to outer ring road via pipeline road.
5. Split Flyover at MEI Junction on Tumkur Road
6. Elevated corridor from Yeshwanthpura (Mathikere cross) – IISC – Mekhri circle Jayamahal – St. John church road – Ulsoor lake – Old Madras Road – KR Puram
7. Elevated corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur Road via Indira Nagar-Domlur-Madiwala
8. Elevated corridor from Ulsoor Junction to Bagalur Junction (extended till BIAL)
9. Elevated corridor from Nagavara Junction – Ramakrishna Hegde Nagar Junction – Sampige Halli – Tirumenahalli – Bella Halli Junction– Bagalur Main road
10. Grade Separator at Kempegowda Circle Old Yelahanka

Other 3 corridors/flyovers require re-consideration due to prevailing site constraints, issues and other factors listed above.

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Observations of DULT on the Proposal Submitted by B-SMILE for Construction of Elevated Roads in Bengaluru

S.N	Proposed Elevated Roads	Observations of DULT
1.	Mysuru Road from Sirsi Circle to Nayandahalli (6.02 Km)	1. The proposed corridor aligns with the proposed elevated corridors in approved CMP Bengaluru 2020 (Refer Fig 4-10 Elevated Road corridors in the CMP). 2. The accurate positions of piers to be provided in the proposed topography plan along with cross sections at the pier locations. Also provide details of carriageway, median, footpath, drain at grade level to identify the locations with space constraints for traffic movement, since Mysuru road witnesses large share of buses and pedestrian movement. 3. A weaving length of only 65m has been proposed in the DPR between the up ramp of the existing BGS flyover and the down ramp of proposed 2-lane unidirectional flyover. As per IRC 92- 2017 "Guidelines for the design of interchanges in urban areas (Ref. fig 7.1), even assuming a conservative speed of 30 kmph and 1000 PCU/lane/hr, a minimum weaving length of 500m must be provided. This weaving length will provide opportunity for merging and diverging of vehicles without significantly reducing traffic speeds. Lowering the weaving length will lead to bottleneck as motorist will need to slowdown to find gaps to change lanes and will lead to shock waves in the traffic stream. Therefore, the proposed weaving length of 65m is grossly inadequate for safe merging/diverging of traffic and will become a major bottleneck point and can potentially become a black spot (high accident location) as well. **Hence, it recommended to adhere to standards and possibly analyse the operations at these stretches through traffic simulations to determine the appropriate weaving lengths and additional safety measures to be implemented and modify the design/DPR accordingly.** Similarly, the **weaving length available between ramp of proposed elevated corridor and ramp up of existing flyover at Nayandahalli must be checked and appropriately addressed as recommended above**. 4. An elevated rotary has been proposed in the DPR to accommodate traffic entering/exiting from NICE road. However, the weaving length provided for traffic streams from outbound on Mysuru Road and that entering from NICE road ramp is very less, similarly

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		weaving length provided for traffic stream inbound on Mysuru Road and diverging to Nice Road ramp seems inadequate. However, as per IRC 65: 1976 (Recommended Practice for Traffic Rotaries) weaving length for rotaries must be atleast 4 times the weaving width. • Elevated rotary has 4 lanes (i.e 4*3.75m = 15m) • Minimum weaving length required to be provided for safe merging/diverging to take place is 60m (4 * 15m). If adequate weaving length is not provided, it could replicate the similar congestion scenario as in the case of existing Hebbal flyover (inadequate weaving length for traffic merging from ORR causing traffic pile up on Hebbal), which is detrimental to the purpose of providing a elevated road. 5. At the intersection of Vrishabhavathi river and Mysuru road, the carriageway narrows down. Due to introduction of columns of proposed elevated corridor and ramps, this stretch (at-grade) will get even more narrow for the traffic movement. This could become a choke point as the stetch of road already faces severe congestion during peak hours and condition could if further space is taken for elevated road columns. Hence a thorough traffic simulation study is recommended to be carried out to understand the impact on at-grade traffic movement before the alignment and column locations are finalized for least impact scenario. 6. At the section where the ramp of elevated corridor is passing underneath the purple line metro track • Minimum vertical clearance of 5.5m required) between at grade level and ramp of elevated corridor • Minimum vertical clearance (min 5.5m required) between elevated corridor and under-surface of purple line metro track Considering the deck thickness of the elevated road and safety margin, atleast 12-13m clearance should available between current ground level and metro viaduct. This may kindly be verified. 7. Additionally, at BHEL junction witnesses traffic congestion regularly. Introduction of additional piers due to proposed elevated corridor might worsen the traffic situation.

		8. The proposed designs do not indicate any wayside stopping provision or shoulder space on the elevated road for emergency management (like vehicle breakdowns, emergency stoppage etc.). Provision for the same must be made at frequent intervals in both directions. 9. The project proposal assumes that 50% of the current traffic will use the proposed elevated corridor, a clear justification must be provided for such an assumption as it is given to understand that the development of the elevated roads may happen on PPP basis and may be tolled. When tolls are introduced, the usage generally reduces as compared to road free for use. 10. Since the proposed elevated corridor spans across 6.02 km, there will be spatial variation in the traffic volume along the corridor. But the DPR mentions of traffic analysis being carried out only at a single point. Therefore, the traffic analysis must be carried out at multiple major junctions to capture traffic volume variation along the corridor. Such assessment should be utilized to estimate the traffic demand, section-wise on both the elevated section and at-grade section. 11. The DPR provides a very basic alignment, plan and a typical cross-section for the elevated corridor. However, due to the placement of columns, ramps for the elevated corridor, there would be alterations to the at-grade road, which may have adverse impact on traffic movement at-grade. The DPR does not provide any information on the following: • Exact footprint of the columns and ramps of the elevated structure on ground • Proposed plan for at-grade road, indicating space provisioned for travel lanes, median, footpath, bus stops, bus bays, autorickshaw stands, parking bays (where required), utilities etc. • Proposed plan for junctions at-grade. It may be noted because of the elevated road columns, junction width, queue holding areas, sight-distance, pedestrian crossings can become compromised, leading to safety issues and choking issues at junctions. 12. It should be noted that 35% of the total trips in Bengaluru is catered by BMTC buses. On Mysuru road significant operations of KSRTC is observed (towards Mysuru, Ooty, Kerala, Veerajpete/Coorg etc). All these buses will continue to use at-grade road as they need

		to access bus stops/ terminals. Similarly, autorickshaw and other IPT will need will also mostly ply at-grade as they need to be accessible to commuters for obtaining rides. Overall improvement in mobility/ travel can only be achieved when both at-grade and the proposed elevated roads are designed comprehensively to achieve maximum combined capacity and operating efficiency. Hence, DPR should provide clarity on how at-grade junctions and mid-block sections will be redeveloped for achieving higher capacity and for improving safety. 13. Only after a comprehensive proposal for the corridor (including at-grade and elevated designs) are prepared, an appropriate assessment of the usefulness and cost-benefit of proposal can be carried out for decision making. In the current form the DPR does not have adequate clarity. 14. Overall costing should include cost for comprehensive development of the corridor and not just the elevated portion.
2.	Yeshwanthpura (Mathikere cross) – IISC – Mekhri circle Jayamahal – St. John church road – Ulsoor lake – Old Madras Road – KR Puram	1. The proposed corridor aligns with the proposed elevated corridors in approved CMP Bengaluru 2020 (Refer Fig 4-10 Elevated Road corridors in the CMP). 2. Submission only includes plan and profile drawings and cost estimates. However, a Detailed Project Report (DPR) with traffic analysis data (as prescribed in section 7.1 of IRC 92:2017 "Guidelines for the design of interchanges in urban areas" for various traffic studies to be conducted) across the corridor is necessary for carrying out evaluation of the proposal. Hence, the same to be furnished for further evaluation. 3. Weaving length of about 170m is available between the up ramp of proposed 4-lane bidirectional elevated corridor and the down ramp of existing Pt. Deendayal Upadhyay flyover, which is grossly inadequate as explained in S.N. 1. **Hence, it recommended to adhere to standards and possibly analyse the operations at these stretches through traffic simulations to determine the appropriate weaving lengths and additional safety measures to be implemented and modify the design/DPR accordingly.** 4. The proposed elevated corridor is of 4 lane divided configuration, and a service road of 5.5m carriageway and 1.5 drain cum footpath is proposed on either side of the elevated corridor. Since the existing traffic conditions witness severe congestion along this stretch, a service road of 5.5m would be insufficient to

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		cater the traffic moving to MS Ramaiah Road and towards Malleswaram, Sankey Road etc. Also, the proposal would require the land acquisition from IISC and also requires cutting down of old trees with large foliage which are considered vital for regulating the local temperature, air quality and maintaining urban biodiversity. 5. Similar land acquisition and issue of cutting of old trees persists at the following locations in the DPR: 6. Introduction of portal columns near Prof C.N.R Rao circle underpass. 7. Widening of at grade road in front of Satish Dhawan Auditorium. Hence, the proposal would require proper environmental/ ecological assessment from concerned authorities. 8. A unidirectional up ramp is proposed from New BEL Road (at the centre of carriageway) connecting to elevated corridor towards KR Puram direction. This proposal along New BEL Road would reduce the carriageway significantly, thereby choking the road. Detailed cross section details are required at both at-grade level and elevated corridor level and an evaluation of the impact on traffic movement on the New BEL Road. The same may be furnished for verification. 9. Detailed cross section details required for the up-ramp proposal from E.Mekhri Square Road connecting the elevated corridor towards Yeshwanthpura direction, as it is not clear in the current DPR about its vertical alignment. 10. A unidirectional downramp is proposed from KR Puram direction on Jay Mahal main road towards Mekhri circle. The weaving length available after the touch down of down ramp is about 50m which is insufficient as explained in S.N 1. 11. One up ramp and one down ramp are proposed on either side of the proposed elevated corridor. The weaving length available to access RT Nagar main road (to CIL road) between the start/end of these ramps is about 50m which is insufficient as per the explanation given in S.N 1. Similar weaving length issues persists in the proposed designs/ DPRs all along the proposed elevated corridor. This needs to be re-assessed and corrected accordingly to avoid bottlenecks and blackspots. 12. Elevated rotary is proposed at Mother Teressa circle near Ulsoor lake. The ramp up portions from the Assaye road connecting to elevated rotary seems incomplete in the proposed Plan and Profile drawings. Also, the weaving length available for the vehicles

		accessing from this road to the rotary is unclear. Therefore, drawings showing detailed dimensions of proposed elevated rotary like weaving length and weaving width to be provided for thorough scrutiny of the proposal. 13. A semi-circular elevated corridor is proposed near Gopalan signature Mall with 2 lanes of elevated corridor continuing towards Tin factory and one lane diverts and ramps down towards Yeshwanthpura direction. The junction point where this diversion begins, a choke point is getting created where 2 lane corridor is changing to single lane. The corresponding section needs to be re-designed to maintain the lane balance as recommended in IRC 92:2017. 14. The DPR proposes 4 lane divided elevated corridor with 2 lanes ramping down and 2 lanes ramping up in front of Gopalan signature mall. The traffic from Yeshwanthpura direction ramps down and meets the reduced carriageway section at ROB near the Gopalan signature mall. This would worsen the traffic condition on Old Madras Road (even more near Benniganahalli metro station) as this section is already severely congested most of the day. 15. Overall improvement in mobility/ travel can only be achieved when both at-grade and the proposed elevated roads are designed comprehensively to achieve maximum combined capacity and operating efficiency. Hence, DPR should provide clarity on how at-grade junctions and mid-block sections will be redeveloped for achieving higher capacity and for improving safety. 16. Only after a comprehensive proposal for the corridor (including at-grade and elevated designs) are prepared, an appropriate assessment of the usefulness and cost-benefit of proposal can be carried out for decision making. In the current form the DPR does not have adequate clarity. 17. Overall costing should include cost for comprehensive development of the corridor and not just the elevated portion.
3.	Adayar Ananda Bhavan Raghuvanahalli Cross, Kanakapura Road	1. Kanakapura road is one of the roads listed in Bengaluru CMP 2020 for corridor improvement plan. The proposed junction for improvement falls within this corridor. 2. As per the traffic data given, the traffic at junction is only 6,400 PCUs/ hour at peak hours and does NOT warrant a grade-separator at this junction as per IRC 92 2017. Moreover, the junction is only a 3-arm junction, and it appears that the delays observed at this junction is due to inadequate management of traffic. These issues can be resolved with proper

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		junction design, signal re-timing and traffic enforcement. 3. Hence, the proposal for flyover at this junction does not seem to be necessary at present and low-cost alternative options may be tried out.
4.	From Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur Road via Indira Nagar-Domlur-Madiwala	1. The proposed alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal be further examined during the revision of the CMP Bengaluru. 2. In the cross section, details of carriageway, median, footpath, drain at grade level have not been provided and the same should be included in the proposal for further verification. 3. Please specify the locations of Classified Volume Count (CVC) surveys and indicate the number of locations considered. 4. Under Section 5.1.6 (Traffic Capacity of Project Road), the claim that "with current PCU/hr at 3996, at least 50% of long-run traffic will use the elevated structure" lacks substantiation. A clear justification must be provided for such an assumption as it is given to understand that the development of the elevated roads may happen on PPP basis and may be tolled. When tolls are introduced, the usage generally reduces as compared to road free for use. 5. In the initial stretch near Chinmaya Hospital, only 39m is available from the ramp down to Sri Krishna Temple Road junction and approximately 100m to Indira Gate junction. As per IRC:92-2017 "Guidelines for the design of interchanges in urban areas" (Fig 7.1), these distances fall far short of the minimum 500m weaving length required for safe merging/diverging (Conservative Speed=30 kmph, PCUs/lane/hr=1000, 4-lane configuration). Conduct traffic simulation analysis for this stretch and propose design enhancements. 6. In Stretch 4, it is unclear whether the proposed flyover passes above or integrates with the existing Domlur flyover. Please provide detailed cross-sections showing vertical clearance and alignment for clarity 7. Detailed drawings for Stretch 5 (Domlur Flyover to Defence Property), Stretch 6 (Defence Property to Ejipura Flyover start), stretch 7 (Ejipura to Madiwala St.john hospital) and stretch 8 (Madiwala underpass) are not provided. 8. The proposed elevated rotary in Stretch 9 at Madiwala Junction appears infeasible due to land limitations. Provide precise details on required land acquisition locations and specifications for further verification. 9. It appears that the elevated road is proposed to go under the viaduct of metro and also the service road

		around the metro station. It may be noted that service roads around metro stations are also earmarked for fire driveways. The service roads also facilitate pick-up/ drop-off for metro users and for feeder bus stops, placing elevated road columns may reduce the space for such uses creating inconvenience to metro users. Hence construction of elevated roads on the service road around metro stations may not be permitted for fire safety reasons. The same needs to be verified by the Fire Department and BMRCL. Please also submit detailed cross-sections illustrating 5.5 m vertical clearance (above and below the metro viaduct), precise alignment, and comprehensive land acquisition details for affected areas. 10. Overall improvement in mobility/ travel can only be achieved when both at-grade and the proposed elevated roads are designed comprehensively to achieve maximum combined capacity and operating efficiency. Hence, DPR should provide clarity on how at-grade junctions and mid-block sections will be redeveloped for achieving higher capacity and for improving safety. 11. Only after a comprehensive proposal for the corridor (including at-grade and elevated designs) are prepared, an appropriate assessment of the usefulness and cost-benefit of proposal can be carried out for decision making. In the current form the DPR does not have adequate clarity. 12. Overall costing should include cost for comprehensive development of the corridor and not just the elevated portion.
5.	Grade Separator at Kempegowda Circle Old Yelahanka	1. The proposed alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal be further examined during the revision of the CMP Bengaluru.
6.	Minerva circle to Hudson circle	1. The proposed elevated alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal be further examined during the revision of the CMP Bengaluru. 2. The current width of road between Minerva Circle and Hudson circle (JC road) is about 5 lanes one-way and has been recently re-developed as concrete road with new footpaths etc. 3. The alignment also has important monuments/ buildings like Town Hall, Ravindra Kalakshetra etc.), elevated corridors may hamper the aesthetics of these monuments. 4. In view of the above, the need to take up elevated corridor on this alignment should be re-considered.
7.	Flyover at Konankunte cross for through traffic	1. Kanakapura road is one of the roads listed in Bengaluru CMP 2020 for corridor improvement plan.

	from kanakapura to banashakakri. from Khodays to konankunte metro station towards kanakapura.	The proposed junction for improvement falls within this corridor. 2. The junction has significant traffic and odd geometry (split junction) which warrants for a grade separation. However, the proposed design has certain limitations that need to be addressed for the grade-separation to be effective in resolving the congestion issue: a. Mall has greater number of pedestrians entry from local areas who walk from vallabanagar, konankunte, vasantpura, doddakkalsandra, jumbusavaridenne, and few parts of jp nagar. With a footpath proposed 1.5 metres under station level and with high intense pedestrian moment for forum mall is not adequate. b. It appears that the elevated road is proposed to go above service road around the metro station. It may be noted that service roads which are barely 4.5m to 7m around metro stations are also earmarked for fire driveways. The service roads also facilitate pick-up/ drop-off for metro users and for feeder bus stops, placing elevated road columns may reduce the space for such uses creating inconvenience to metro users. Hence construction of elevated roads on the service road around metro stations may not be permitted for fire safety reasons. The same needs to be verified by the Fire Department and BMRCL. c. Horizontal intersection point next to metro station towards industrial area the elevated corridor has 5 hip bends of total, these bends will create bottle neck situations because of no clear cut turning radius. This may need to be addressed. d. Ramp down is provided just before Vasanthapura main road, which is already as congested junction. Flyover will bring more traffic to the junction resulting worsening the congestion levels. Hence, feasibility of moving the down ramp beyond the junction by acquiring additional land should be examined. So that the proposal results in proper de-congestion of the junction.
8.	Elevated corridor from west of chord road to outer ring road via pipeline road.	1. The proposed elevated alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal may be further examined during the revision of the CMP Bengaluru.
9.	Elevated corridor from Nagahara junction-Ramakrishna Hegde Nagar junction- Sampigehalli-Tirumenahalli- Bellahalli junction – Bagalur main road.	1. The proposed elevated alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal may be further examined during the revision of the CMP Bengaluru.

	From Marenahalli main road from Ragi Gudda to 7th main junction thereby connecting Kanakapura main road till Thalaghattapura NICE road via pipeline road	1. The proposed elevated alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal may be further examined during the revision of the CMP Bengaluru.
10.	Ulsoor Junction to Bagalur Junction	1. The proposed alignment does not fully align with Bangalore's Comprehensive Mobility Plan (CMP) corridor improvement strategy. Section only from Ulsoor Junction to ORR (Hennur Flyover) is mentioned in the CMP 2020. This proposal may be reexamined in the updated CMP. 2. Kindly assess the availability of additional right-of-way space for up and down ramp construction near Ulsoor Junction (chainage 300–800m), as carriageway modifications will likely require relocation of multiple existing trees. 3. Please verify the feasibility of pier construction from Sidhi Colony Junction to Bangalore East Railway Station (chainage 1050–1700m), given the narrow road width and densely built-up surroundings. 4. Construction of the proposed up and down ramps immediately before Hennur Main Road flyover will likely encroach upon Charles Playground, necessitating land acquisition. Please examine the same and incorporate accordingly.
11.	Split Flyover at MEI Junction on Tumkur Road	1. The proposal is covered in the Bengaluru CMP 2020 and hence may be examined in the revision of the CMP and suitably considered. 2. While the cost estimate and preliminary plans have been submitted, a Detailed Project Report (DPR) is required to assess whether the PCU volumes justify the provision of a grade separator at the proposed location, in accordance with IRC 92 -2017 guidelines. 3. Based on the submitted drawings, the service road carriageway width at the MEI roadside is 3.5 m. Given that MEI Road serves as a key access route to an industrial hub and has high volumes of heavy vehicles accessing the road, it is recommended that the carriageway width be increased. 4. It is recommended that the proposed vertical clearance of the flyover be specified and evaluated for feasibility, considering the expected commercial vehicle movement on both sides of the at-grade roadway. 5. The major junction at Gurugunte Palya is located approximately 500 m from the MEI Junction, and the

		proposed ramp begins at about 200 m from the junction. As the junction currently functions as a bottleneck during peak hours, the introduction of the ramp may further aggravate traffic congestion. This aspect requires detailed examination in conjunction with prevailing traffic conditions. 6. At one side road widening is proposed near the starting point of the approach ramp to overall flyover and down ramp. It is necessary to verify whether adequate land is available to accommodate the service road and footpath, as this stretch experiences high pedestrian movement due to the presence of a metro station and bus stops.
12.	Elevated corridor from Nagavara Junction – Ramakrishna Hegde Nagar Junction – Sampige Halli – Tirumenahalli – Bella Halli Junction– Bagalur Main road	1. The proposed elevated alignment is not considered in Bangalore's Comprehensive Mobility Plan (CMP) 2020. Hence, the proposal may be further examined during the revision of the CMP Bengaluru. 2. Although the cost estimate and preliminary plans have been submitted, a Detailed Project Report (DPR) is required to evaluate whether the projected PCU volumes warrant the provision of a grade separator at the proposed location, in accordance with IRC 92:2017 guidelines. 3. The approach ramp near Tannery Road proposes road widening to accommodate a four-lane elevated corridor along with a service road and footpath at grade level. However, the existing right-of-way (RoW) appears insufficient to support the proposed lane configuration even after land acquisition this may leads to traffic congestion and Bottleneck.

File No. GBA/15/2026-B-SMILE (Computer No. 2030491)
Generated from eOffice by SHAMANTH P KUCHANGI, DULT-HTC-TECH(SK), TECHNICAL HEAD, DIRECTORATE OF URBAN LAND TRANSPORT on 29/0

Siddi Shakthi Projects (Formerly NEZ Infratech Pvt. Ltd.)
No.93/31, Asha Nivas, TG Layout, Ittamadu, Banashankari 3 rd Stage, Hosakerehalli Post, Bengaluru-560085
Phone No : + 91 80 43008989, Email : siddishakthiprojects@gmail.com, ssprj2001@gmail.com.

REF: SSP/QTN/25-26/0104 **Date: 07-02-2026**

To,

The Chief Engineer -03,
Bengaluru Smart Infrastructure Limited (B-SMILE),
Room No.108, 1st Floor, Annex -2 Building,
N.R. Square, Bengaluru 560002.

Sub: 1. Construction of Proposed Elevated Corridor from Sirsi Circle to Nayanadahalli on Mysuru Road.
2. Construction of Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur Road via Indiranagar –Domlur - Madiwala.

Ref :

1. Observations by Technical head, DULT on elevated roads in Bengaluru Dated:29-01-2026
2. Review meeting held at the office of Additional Chief Secretary, UDD on 29-01-2026.
3. Review meeting held at the office of Director (Technical) on 01-02-2026.
4. Observations by Technical head, DULT on elevated roads in Bengaluru on 03-02-2026.
5. Review meeting held at the office of Director technical with DULT on 06-02-2026

Dear Sir,

Referring to the above, we have finalized the drawings and estimates for the above 2 projects based on the observations and recommendations given by B-Smile & Technical head, Directorate of Urban Land Transport (DULT) the details of the Projects are shown in the table below.

Sl. No.	Name of Project	Original DPR Cost (in Crore)	Revised DPR Cost (in Crore)
1	Construction of Proposed Elevated Corridor from Sirsi Circle to Nayanadahalli on Mysuru Road	782.00	810.00
2	Construction of Proposed Elevated Corridor from Old Madras Road from Swami Vivekananda Metro Station to Silk Board Junction on Hosur Road via Indiranagar –Domlur - Madiwala	986.00	1300.00

We do here by certify that the revised estimates are in line with designs, drawings and as per standards for the respective corridor.

We have enclosed reply to the observations and recommendations given by Technical Head, DULT on elevated corridor projects of above 2 projects along with this letter.

Yours faithfully,

For Siddi Shakthi Projects,

Authorized Signatory

All the comments and recommendations are noted.

Sl.No.	Proposed Elevated Corridor	Recommendations from DULT	Reply
4.	**Mysuru Road from Sirsi Circle to Nayandahalli.**	Proposal is agreed to be taken up by incorporating the following: • At all locations, the following configuration for the entry and exit ramps shall be followed: - All entry and exit ramps shall be of 1 lane of 4.5 to 5.5m Width. - Wherever the entry ramp/ exit ramp merges/diverges from the main elevated lanes, a minimum tapering distance of 200m shall be Provided to Facilitate smooth merging/ diverging of vehicles.	**Noted the Comments** Clear carriageway width of 5.5m is proposed at all entry and exit ramps with a tapering distance of 200m to Facilitate smooth merging and diverging of traffic.
		• The tapering provided for traffic diverging from the existing BGS Flyover to the proposed elevated road (towards Nayandahalli) shall be smooth with a tapering length of atleast 200m. so that motorists need not significantly reduce their vehicle speed for diverting to the proposed elevated road.	Smooth tapering of 200m is provided at traffic diverging from the existing BGS Flyover to the proposed elevated road of width 8.50m (towards Nayandahalli)
		• Inbound lanes (towards KR Market)-2 Lanes should connect to the existing BGS Flyover, so that vehicles going towards KR Market can continue at the elevated Level, without the need to merge with the atgrade traffic. Only 1 exit Lane shall be provided before the Sirsi Circle for Commuters heading towards Binny mill or TR Mills.	Independent loop of 7.0m is provided from proposed elevated corridor from Nayandahalli to the existing BGS flyover towards Market and only exit lane of 7.0m is provided before sirsi circle while landing from nayandahalli.
		• Proposed up-ramp from Nice Road (at Gali Anjaneya Junction) shall be removed as the traffic from this up-ramp moving towards KR Market will need to cut across 3 lanes of straight traffic going towards Nayandahalli at the proposed elevated round about, which can lead to congestion on the elevated road.	Proposed up-ramp from Nice road and elevated rotary is removed
		• Emergency bays adjacent to the travel lanes may be provisional on the elevated roads, preferably at 2-3 km spacing (and where RoW is available) to facilitate emergency stoppage of vehicle or shifting of stall vehicles, parking of towing/ enforcement vehicles etc.	Emergency bays are included in the proposal

Sl.No.	Proposed Elevated Corridor	Recommendations from DULT	Reply
		• At the at-grade level, a minimum unobstructed footpath width of 2m - 2.5m shall be provided on either side of the road (without obstruction of columns utilities or other objects) to facilitate safe and convenient walking environment for pedestrians. Footpath shall be continuos, Smooth, and not higher than 0.15m from road level and with access ramps to ensure footpaths are universally accessible to people of all abilities.	Minimum footpath width of 2.5m is proposed with kerb height not more than 0.15m from road lelvel.
		• As Mysuru Road has high frequency of bus movement at-grade, provision for bus priority lane should be provisioned, wherever 3 lanes are available at-grade. At all bus stops along the roads, Proper bus shelters, Signage, Lighting shall be provisioned.	Bus priority lane with bus shelters are provided at surface level wherever 3 lanes are available
		• At junction at-grade, the columns of the elevated road shall be so designed and located that the capacity the junctions for all directional movements, queue holding capacity, adequate safe sight distance and pedestrian crossing are not compromised. The concessionaire or contractor shall ensure the same while preparing details design and construction.	Pier locations are positioned at the center of median and portal frame structures are proposed to retain the existing road width as it is
		• Costing necessary for at-grade improvement shall be included in the overall project cost. Subject to incorporating the above, approval may be accorded for taking up implementation of this corridor.	Project cost is revised incorporating all the above comments and recommendations. The revised Detailed project cost is Rs. 810.00cr & the original Detailed Project cost was Rs.782.00cr

Sl. No.	Proposed Elevated Corridor	Recommendations from DULT	Reply
10	**From Old Madras Road From Swami Vivekananda Metro Station to Silk Board Junction On Hosur Road Via Indira Nagar-Domlur - Madiwala**	Proposal is agreed to be taken up by incorporating the following: • At all Location, only 1 lane entry ramp shall be provided and wherever the entry ramp/ exit ramp merges/diverges from the main elevated lanes, a minimum tapering distance of 200m Shall be provided to facilitate smooth merging / diverging of vehicles.	Clear carriageway width of 5.5m is proposed at all entry and exit ramps with a tapering distance of 200m to Facilitate smooth merging and diverging of traffic.
		• The 2-lane elevated road alignment has sharp turning radius at CMH signal (80ft Rd & CMH Road) and junction of CMH Road and 100ft Rd., which may be unsafe. The road width at turning should be widened (about 4.5m may be Provisioned) for larger vehicles to turn; appropriate super elevation should be provided; on the approach to these curves, rumble strips to be installed to slow/ alert motorists to slow down.	Due to Site constrain curve radius of 70m is adopted at CMH signal and 100ft road providing extra width in curves with rumble strips
		• As the proposed elevated road on 100ft road approaches Domlur flyover, the elevated road columns should be in the central median to avoid encroachment to footpath or road. Efforts shall be made while finalizing designs and during construction to minimize impact on existing trees on 100 ft road.	Pier locations are proposed at center of median near Domlur flyover
		• It is proposed to provide a single lane exit ramp prior to Domlur Flyover to facilitate traffic from Indiranagar side to exit towards HAL Airport.	Exit lane from Indiranagar towards HAL airport road is included in the proposal
		• The elevated road coming from the elevated rotary to 100 ft Road Koramangala, should directly merge with the under construction Ejipura Flyover, this would require modification/ removal of the under construction Ejipura ramp on 100 ft Rd. Koramangala.	Ejipura ramp near Koramanagala which is under construction is integrated with the current proposal
		• Emergency bays adjacent to the travel lanes may be provisioned on the elevated roads, preferably at 2-3 km spacing (and where RoW is available) to facilitate emergency stoppage of vehicles or shifting of stall vehicles, parking of towing/ enforcement vehicles etc.	Emergency bays are included in the proposal

Sl. No.	Proposed Elevated Corridor	Recommendations from DULT	Reply
		• At the at-grade level, a minimum unobstructed footpath width of 2m-2.5m shall be provided on either side of the road (without obstruction of columns utilities or other objects) to facilitate safe and convenient walking environment for pedestrians. Footpath shall be continuous, smooth, and not higher than 0.15m from road level and with access ramps to ensure footpaths are universally accessible to people of all abilities.	Minimum footpath width of 2.5m is proposed with kerb height not more than 0.15m from road lelvel
		• At all bus stops along the roads, proper bus shelters, signage, lighting shall be provisioned.	Bus priority lane with bus shelters are included at surface level wherever 3 lanes are available signages and lightings are also included in the proposal.
		• At junctions at-grade, the columns of the elevated road shall be so designed and located that the capacity the junctions for all directional movements, queue holding capacity, adequate safe sight distance and pedestrian crossings are not compromised. The concessionaire or contractor shall ensure the same while preparing detailed designs and construction.	Pier locations are positioned at the center of median and portal frame structures are proposed to retain the existing road width as it is
		• Costing necessary for at-grade improvement shall be included in the overall project cost.	Project cost is revised incorporating all the above comments and recommendations. The revised Detailed project cost is Rs. 1300.00cr & the original Detailed Project cost was Rs.986.00cr

ಕರ್ನಾಟಕ ಸರ್ಕಾರ

ಸಂಖ್ಯೆ: ನಅಇ 163 ಎಂಎನ್‌ವೈ 2025 (ಭಾಗ-2)

ಕರ್ನಾಟಕ ಸರ್ಕಾರ ಸಚಿವಾಲಯ,
ವಿಕಾಸಸೌಧ,
ಡಾ|| ಬಿ.ಆರ್.ಅಂಬೇಡ್ಕರ್ ವೀಧಿ,
ಬೆಂಗಳೂರು, ದಿನಾಂಕ:11-02-2026.

ಇವರಿಂದ,

ಸರ್ಕಾರದ ಅಪರ ಮುಖ್ಯ ಕಾರ್ಯದರ್ಶಿ,
ನಗರಾಭಿವೃದ್ಧಿ ಇಲಾಖೆ,
ವಿಕಾಸಸೌಧ, ಬೆಂಗಳೂರು.

ಇವರಿಗೆ,

ವ್ಯವಸ್ಥಾಪಕ ನಿರ್ದೇಶಕರು,
ಬೆಂಗಳೂರು ಸ್ಮಾರ್ಟ್ ಇನ್ಫ್ರಾಸ್ಟ್ರಕ್ಚರ್ ಲಿಮಿಟೆಡ್,
ವಸಂತನಗರ, ಬೆಂಗಳೂರು.

ಮಾನ್ಯರೇ,

ವಿಷಯ: ಬೆಂಗಳೂರು ಸ್ಮಾರ್ಟ್ ಇನ್ಫ್ರಾಸ್ಟ್ರಕ್ಚರ್ ಲಿಮಿಟೆಡ್ ಸಂಸ್ಥೆಯಿಂದ ಗ್ರೇಟರ್ ಬೆಂಗಳೂರು ಪ್ರಾಧಿಕಾರದ ಐದು ನಗರಪಾಲಿಕೆಗಳ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಸುಮಾರು 120.10ಕಿ.ಮೀ ಉದ್ದದ ಎಲಿವೇಟೆಡ್ (ಎತ್ತರಿಸಿದ ರಸ್ತೆಗಳ) ಕಾರಿಡಾರ್ ಯೋಜನೆಯ, ರೂ.11801.08ಕೋಟಿಗಳ ಅಂದಾಜು ಮೊತ್ತಕ್ಕೆ ಆಡಳಿತಾತ್ಮಕ ಅನುಮೋದನೆ ನೀಡುವ ಬಗ್ಗೆ.

ಉಲ್ಲೇಖ: ತಮ್ಮ ಪ್ರಸ್ತಾವನೆ ಸಂಖ್ಯೆ:ಬಿ-ಸ್ಮೈಲ್/ನಿ(ತಾಂ)/ ಪಿ.ಆರ್/ 561/2025-26, ದಿನಾಂಕ:09-02-2026.

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ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, ಉಲ್ಲೇಖಿತ ಪ್ರಸ್ತಾವನೆಯನ್ನು ಪರಿಶೀಲಿಸಲಾಗಿ, ಪ್ರಸ್ತಾವನೆಯನ್ನು ಸಚಿವ ಸಂಪುಟದ ಮುಂದೆ ಮಂಡಿಸುವ ಸಂಬಂಧ ನಾಲ್ಕು ಪರಿಣಿತ ಯೋಜನಾ ಸಮಾಲೋಚಕರು ನೀಡಿದ ವಿಸ್ತೃತ ಯೋಜನಾ ವರದಿಗಳು (ಡಿಪಿಆರ್), M/s DULT ನೀಡಿರುವ ಅಭಿಪ್ರಾಯ/ಸಲಹೆಗಳು, ನಕ್ಷೆಗಳು ಮತ್ತು ಪೂರಕ ದಾಖಲೆಗಳ ಭೌತಿಕ/ತಂತ್ರಾಂಶದ ಪ್ರತಿಗಳನ್ನು ಕೂಡಲೇ ಮರುಟಪಾಲಿನಲ್ಲಿ ಒದಗಿಸುವಂತೆ, ತಮ್ಮನ್ನು ಕೋರಲು ನಿರ್ದೇಶಿತನಾಗಿದ್ದೇನೆ.

ತಮ್ಮ ನಂಬುಗೆಯ,

(ಲಕ್ಷ್ಮೀಸಾಗರ್ ಎನ್.ಕೆ.)
ಸರ್ಕಾರದ ಅಧೀನ ಕಾರ್ಯದರ್ಶಿ,
ನಗರಾಭಿವೃದ್ಧಿ ಇಲಾಖೆ (ಜಿಬಿಎ & ಬಿಸಿಸಿ-1)

ಪ್ರತಿ:

1. ಪ್ರಧಾನ ಅಭಿಯಂತರರು ಮತ್ತು ನಿರ್ದೇಶಕರು (ತಾಂತ್ರಿಕ), ಬಿ-ಸ್ಮೈಲ್, ವಸಂತನಗರ, ಬೆಂಗಳೂರು.
2. ಮುಖ್ಯ ಅಭಿಯಂತರರು, ಬಿ-ಸ್ಮೈಲ್, ವಸಂತನಗರ, ಬೆಂಗಳೂರು.

SCOPE OF WORK AND DESIGN CRITERIA FOR CONTRACT

(To be referred along with tender document/RFP)

1.0 Scope of Work

1.1 General

The Government of Karnataka is according high priority to the development of core urban infrastructure in Bengaluru, considering the city's significant contribution to the State economy and its rapidly increasing transportation demand. In this regard, the Government has established a Special Purpose Vehicle, Bengaluru Smart Infrastructure Limited (B-SMILE), for effective utilisation of Government grants towards implementation of major infrastructure projects on priority basis. As part of this initiative, the Government has accorded in-principle approval for development of approximately 120 km of elevated corridors, flyovers and grade separators across Bengaluru city with an initial allocation of Rs. 7,000 Crores to facilitate seamless and uninterrupted urban mobility.

Under this programme, B-SMILE proposes to implement an elevated corridor from Sirsi Circle to Nayandahalli on Mysuru Road (Length 5.2kms) in Bengaluru city under EPC Mode on Lumpsum, Trunkey with allowable Price escalation using UHPFRC based structures. The proposed corridor is envisaged to improve traffic efficiency, reduce travel time and enhance connectivity between the eastern and southern parts of Bengaluru.

The proposed elevated corridor is planned to be executed using advanced construction technologies including slim-type superstructure systems with Ultra High Performance Fibre Reinforced Concrete (UHPFRC) girders, enabling longer spans, reduced structural depth, faster construction and minimal disruption to existing traffic during implementation.

In this context, B-SMILE invites bids from eligible Tenderers on an Engineering, Procurement and Construction (EPC) basis, adopting the Tenderer's own design approach in accordance with the key parameters specified by B-SMILE. Provision for one Alternate Proposal is permitted, subject to compliance with relevant Indian and International Standards and approval by B-SMILE. The location and extent of the project corridor are described in the subsequent sections of the tender document.

Tenderers shall submit only one Proposal. Additional Proposal / s shall result in the Disqualification of the Tenderer.

The Turnkey Contract based on the Contractor's own design shall include, but not be limited to, carrying out Topographical Surveys, Geotechnical Investigations, utility investigations, traffic studies, and all other ancillary investigations and works necessary for the planning, design, engineering, execution, testing, commissioning, and completion of the Project. The scope shall further include provision of all labour, materials, casting yards, construction equipment, tools, plants, machinery, temporary works, fabrication facilities, launching arrangements, testing facilities, and all resources required for successful execution of the Works.

The Works comprise construction of the Elevated Corridor with modern precast superstructure systems consisting of U-Girders, Strutted Box Girders, and Ultra High Fibre Reinforced Concrete (UHFRC) structural components, including UHFRC I-Girders for long-span portal frame arrangements, complete in all respects as indicated in the Concept Drawings and detailed designs approved by the Employer. The scope shall also include construction of elevated rotary structures at identified junctions using strutted box girder systems, integration with and connection to existing flyovers at first-level configurations, and provision of second-level flyover connectivity crossing above existing flyovers through portal frame arrangements supported on UHFRC I-Girders.

The Contract shall further include construction of all merging and diverging loops, ramps, slip roads, approaches, and connections to existing elevated corridors and road networks, together with associated civil, structural, electrical, mechanical, and traffic engineering works. The scope shall include construction and completion of drainage systems, medians, traffic islands, box culverts, retaining structures (temporary and permanent), compound walls for CPWD quarters wherever affected, road furniture, crash barriers, noise barriers, road markings, signage systems, painting and protective coatings, illumination and electrical installations for grade separators and elevated structures, landscaping works, utility shifting/protection works, safety measures, traffic diversion arrangements

during construction, and all other appurtenant works necessary for completion and operational functionality of the Project.

The Contractor shall coordinate with all concerned Government Departments, Utility Agencies and Statutory Authorities for identification, protection, diversion, relocation and shifting of existing utilities falling within the Project limits, including preparation and submission of drawings, estimates, proposals, demand applications and all necessary documents required for obtaining approvals and utility shifting permissions.

All statutory utility shifting charges, supervision charges, departmental deposits, restoration charges, demand note amounts and other payments payable to Government Departments, Utility Agencies or Statutory Authorities towards utility shifting/relocation shall be borne and remitted by the Employer/Client directly to the concerned authorities. However, the Contractor shall provide all necessary technical assistance, liaisoning support, documentation, survey details, traffic arrangements and coordination required for processing and execution of such utility shifting works.

In the event the Contractor, with prior approval of the Employer/Engineer-in-Charge, remits any utility shifting charges or deposits to the concerned authority for expeditious execution of the Project, the same shall be reimbursed to the Contractor upon submission of original demand notes, paid challans/receipts, supporting correspondence and proof of payment to the satisfaction of the Employer.

The Contractor shall be solely responsible for the adequacy, stability, safety, quality, durability, and performance of the design and construction, and shall execute the Works in compliance with applicable IRC, MORTH, BIS, and other relevant codes, standards, specifications, statutory requirements, and directions of the Employer/Engineer-in-Charge.

The quoted Contract Price shall be deemed to include all costs towards taxes, duties, levies, royalties, licence fees, patent rights, insurance, labour cess, ESI, PF contributions, municipal and local taxes, octroi, transportation, loading/unloading, incidental expenses, and all other statutory obligations applicable to the execution of the Works, excluding Goods and Services Tax (GST). GST at applicable rates prevailing at the time of payment shall be paid separately as admissible under the Contract. No additional claim or compensation on account of any such taxes, duties, levies, or incidental charges shall be entertained by the Employer.

1.2 Site

The proposed Project Road for "Construction of Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road (Length approximately 5.2 km) in Bengaluru City" is situated within Bengaluru Urban Area, Karnataka, and traverses along the major urban arterial corridor of Mysuru Road connecting Sirsi Circle, Vijayanagara, Gopalan Arcade Corridor, Gali Anjaneya Temple Junction and Nayandahalli Junction.

The Project Corridor commences from Sirsi Circle Junction and generally follows the existing Mysuru Road corridor towards Nayandahalli existing elevated flyover. The proposed alignment passes through major urban traffic influence zones including Sirsi Circle, Chamarajpet connectivity zone, Vijayanagara, Gopalan Mall Junction, Gali Anjaneya Temple Junction and Nayandahalli Junction, integrating with existing flyovers, grade separators, metro infrastructure and major arterial road networks within Bengaluru City.

The proposed elevated corridor consists of split elevated carriageway/loop flyover arrangements and bi-directional elevated viaduct systems planned to optimize traffic distribution, reduce congestion at major junctions and provide uninterrupted grade-separated traffic movement along the Mysuru Road corridor.

From Sirsi Circle to Gopalan Mall Junction, split/loop elevated flyover systems are proposed to facilitate directional traffic dispersal and integration with adjoining junction movements. From Gopalan Mall Junction up to Gali Anjaneya Temple Junction, a bi-directional elevated corridor configuration is proposed. Further, from Gali Anjaneya Temple Junction up to the existing Nayandahalli Flyover, split elevated carriageway systems are proposed for directional traffic segregation and smooth connectivity with the existing elevated road network.

Traffic movement from Vijayanagara side towards Sirsi Circle is proposed to be integrated through the existing flyover structure near Gali Anjaneya Temple Junction by means of suitably designed cantilever structural systems, portal frame arrangements and elevated connectivity structures to merge with the proposed bi-directional elevated corridor towards Sirsi Circle.

The proposed elevated corridor shall provide seamless traffic integration with the existing Nayandahalli Flyover system and other existing grade separators/flyovers along Mysuru Road, thereby enabling continuous and efficient vehicular movement between Central Bengaluru and the western corridor of Bengaluru City.

The corridor primarily follows the existing Mysuru Road right-of-way and includes elevated viaducts, split carriageways, loop ramps, portal frame structures, cantilever pier arrangements, entry/exit ramps, slip roads, junction improvement works, utility integration works, traffic management systems and associated civil, structural, drainage, illumination and road infrastructure works as indicated in the Concept Alignment Drawings.

The Location of the Project is shown below:

1.3 Works to be carried out

The Works to be carried out under this Turnkey Contract shall include

a. Preliminary works including setting out of the alignment, establishment and maintenance of permanent benchmarks and reference points, detailed engineering design, preparation and obtaining approval of the General Alignment Drawings (GAD) for the Elevated Corridor along with connected ramps on all sides of the junction roads including approach roads. The scope shall also include preparation and approval of the general alignment for the proposed elevated corridor extending from Sirsi Circle to Nayandahalli on Mysuru Road (Length 5.2kms) in Bengaluru city.

b. Clearing of Site before Commencement of Work and Site Clearance at Acquired Government and Private Property, if any.

c. Topographical Survey and Setting out of Works.

d. **Geotechnical Investigations and taking Trial Bores**: The Geotechnical Investigation Results given in this Document is only indicative and the same is shown in the Tender drawing. The Tenderer shall make his own Assessment and his Lump Sum Offer is for the whole Item of the Work, (All the Items described in this Tender Document and Drawings) and for any Variations observed at Site in respect of Levels and Soil Particulars, etc. The Tenderer's offer is deemed to have been made considering the Actual Ground Conditions at Site and he shall not be eligible for any claim whatsoever. During Execution of the Work, the Contractor shall carry out Geotechnical Investigation as per IRC: 78 at all Piers / Abutments of elevated corridor, at Selected Points of Retaining Wall, and at any other Locations required for the Design of the Works in conformity to the Prevailing Norms and Codal Provisions.

e. The Successful Tenderer, on Award of Work, shall map all the Existing Service Lines, above and below the ground level within the Battery Limit, such as Water Supply, Underground Drainage, Electrical, Telephone, Optical Fibre Cables, etc. Mapping of the Service Lines below the Ground Level shall be carried out using Ground Penetrating Radar (GPR) Equipment. Mapping shall be submitted to Authority (Client) for getting approval and estimation from all the respective Service Departments.

f. Relocation of Utility and Service Lines such as Water Supply, Underground Drainage, Electrical, Telephone, Optical Fibre Cables, etc. those are incidental and obstructing, are to be permanently diverted in an acceptable manner to the Concerned Service Departments so that not to hinder the Services of the Lines at the Cost of the Employer. The Shifting, Supervision Charges, Deposits, if any, to be payable to the Concerned Government Departments shall be borne by the Employer. The Employer will help in Liaising with the Concerned Authorities regarding the Need to shift the Service Lines in case of requirement. Based on his own Investigations as mentioned in the above Clause the Contractor shall make his own Plan for Provision / Diversion of the Service Lines and ascertain the entire Scope of Work and other Required Details by himself and the Employer shall not take any responsibility other than remitting the shifting charges /Liaisoning with the Concerned Departments as stated above. The Time Schedule of 24 (Twenty Four) Months is inclusive of the Period of Utility Shifting also and no Extension of Time would be granted due to Delay in this Work without valid reason. No Monetary Claim in whatsoever manner shall be entertained separately.

g. Removal and Relocation of Existing Bus Shelters within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer. The employer will bear the costs of removal and relocation.

h. Shifting of Existing Kerb Stones within the Battery Limit, if any, to the Location within or beyond the Battery Limits as approved by the Employer.

i. Removal of Existing Traffic Signages and Signals within the Battery Limit, if any, as approved by the Employer.

j. Removal of Existing Hoardings, Advertisement Boards and Appurtenant Structures within the Battery Limit, if any, as approved by the Employer.

k. Dismantling of existing road at median locations for piling works and Disposal of Earth / Debris of existing RCC and Masonry Structures, PCC, existing Road Pavements, RCC / SSM Drainage Structures, Tree Roots, Culverts, Medians, Kerbs, Traffic Islands, Earth Retaining Structures, Ducts, Hoarding and Advertisement Boards and Appurtenant Structures, etc. required for the Execution of the Work.

l. Salvage Value Adjustment and Ownership of Recovered Materials
The estimated project cost and tender value have been prepared after accounting for the salvage value of recoverable materials expected to be generated from dismantling, demolition, site clearance, and tree-cutting activities associated with the work. The scope includes dismantling of existing road pavements at median locations for piling works, demolition and disposal of earth/debris arising from existing RCC and masonry structures, PCC, road pavements, RCC/SSM drainage structures, culverts, medians, kerbs, traffic islands, earth-retaining structures, ducts, hoardings, advertisement boards, tree roots, and all other appurtenant structures required for execution of the project.

The salvage value of reusable materials has already been deducted from the estimated project cost based on the quantities assessed during project preparation, comprising approximately 370 Cum of reusable concrete aggregates recoverable from 3,705 Cum of dismantled concrete @ 100/cum, about 0.85MT of scrap HYSD reinforcement steel recoverable from dismantled RCC structures @ 39505/MT, and approximately 20 MT of timber/wood recoverable from tree-cutting operations @ 2500/mt. The total assessed salvage value considered for recovery in the estimated cost is Rs.1,19,977/-.

Accordingly, all salvage materials covered under the Schedule of Credit, including reusable concrete aggregates, scrap reinforcement steel, timber/wood from felled trees, and other listed recoverable materials, shall become the property of the Contractor, who shall be permitted to remove, reuse, recycle, auction, or otherwise dispose of such materials at his own discretion, without any additional payment from the Employer, since the corresponding salvage value has already been adjusted in the project cost. The rates adopted for salvage value assessment are fixed by the Department and no claim whatsoever shall be entertained on account of any variation between the assessed salvage value and the actual market value realized by the Contractor.
The quantities of salvage materials indicated are provisional estimates only, and the actual quantities shall be determined based on measurements recorded during execution. Any materials obtained from demolition or dismantling activities but not specifically included in the Schedule of Credit shall remain the property of the Employer/Government and shall be handed over to the Engineer-in-Charge/BSMILE without any extra payment or compensation to the Contractor.

m. Construction of Temporary and Permanent Earth Retaining Structures, Compound, Barrication, Fencing, Dewatering, Drainage Facilities and all Temporary Structures wherever required during Construction.

n. Regarding of existing Ground Levels to achieve the required Vertical Clearance for elevated flyover for first and second levels, Drainages, etc. including Disposal of Excavated Earth and Debris to the Location identified by the Contractor where the same shall not cause Nuisance and shall be acceptable to the Authorities concerned.

o. **Traffic Diversion**: Within project road scope area, the tenderer shall ensure that the Traffic Movement during the Construction of the Works is properly diverted, maintained and obstruction to the Traffic Movement is kept to the minimum. Traffic Movement in Construction area shall include but not be limited to the following.

- Preparation of the diversion plan in consultations with Client or his representative and shall be submitted to Client for further approval from Concern department /Police for their approval and public notification if any.
- All Necessary Arrangements required at various location as per approved plan i.e. Sign boards, Cautionary Boards and delineators to warn, inform, guide and control drivers/ riders etc. to be provided.
- Provide Skilled Flagmen for Traffic Diversion as per the Requirement of Concerned Department.

- Provide Traffic Barricades with Blinkers, Reflective Tapes, Road Delineators, Traffic Cones, Portable Signage's, Reflective Lights and other necessary Traffic Signage as required, as directed by the Concerned Authorities and as per the Specification. Construction zone area.

- Prior approval of Traffic Diversion plan from the employer is necessary. If any new diversion road work requires for smooth traffic flow Tenderer to execute work with prior approval of Authority under Additional / Variation work as per special condition clause no 67 i.e. variation.

- After Completion of the Work, if in opinion of Authority wearing course/40mm Bituminous Concrete/Micro surfacing on diverted road are requiring than Tenderer should execute the work at the cost of employer.

p. **Barrication around the Construction Area**

- The Contractor shall be required to keep the Site as Safe and Secure as possible at all times, including the Erection of Site Perimeter Hoarding, which shall also deter trespassers both adult and children alike, as per the Approval of the Employer.
- The Contractor shall provide a solid two meter high securely erected Barricade including Lights over Barricades at night around the perimeter of the Site as per the Approval of the Employer, with Agreed and Guarded Access and Egress Points for both personnel and vehicles.
- At each entrance to the Site, the Contractor shall erect a large Billboard warning all persons who enter the Site that they are required to wear the Appropriate Personal Protective Clothing and that no Unauthorized Access is allowable.
- Wherever the Barricade borders on Pedestrian Footpath, Lightings shall be provided to illuminate the Pedestrian Routes. The Positioning of the Barricade Line shall not reduce the Width of Pedestrian Footpath to less than 900mm.
- Site Perimeter Barricade shall be washed at least once a month and repainted at least annually.
- The Site Barricade shall need to be inspected on a regular basis in order to ensure that the Integrity of the Fencing is maintained at all times as far as practicable.

q. Providing and Erecting Project Information Display Board (minimum size 2.5m X 1.5m) at minimum ten (10) different locations in and around the Project Area as approved by the Employer.

r. The Successful Tenderer, on Award of Work, shall coordinate with KPWD, NHAI Traffic Police, BDA, BESCOM, BSNL, BWSSB, BMRCL, KPTCL, B-SMILE and other Agencies associated with the Construction of Works and comply with their Requirements. The Employer will provide assistance only.

s. The Successful Tenderer, upon award of the Work, shall prepare detailed General Alignment Drawings (GAD) for the proposed Elevated Corridor, including approaches, elevated rotary structures at junctions, second-level elevated structures, and portal frame locations, in consultation with the concerned BSMILE Engineers. The Contractor shall obtain in-principle approval of the detailed GAD from an approved Third-Party Proof Consultant such as Indian Institute of Technology / Indian Institute of Science by following applicable IRC guidelines and procedures prior to commencement of the Works.

The submission for Third-Party scrutiny and approval shall include, but not be limited to:

i. GAD Checklist and compliance statement as per applicable IRC provisions and standards;

ii. Detailed structural design calculations, drawings, analysis reports, and design basis reports for the proposed Elevated Corridor, elevated rotary structures, portal frames, ramps, and associated structures; and

iii. Detailed Geotechnical Investigation Reports for each pier/foundation location of the elevated corridor, duly signed and sealed by the investigating authority on each page, indicating existing ground levels, reduced levels at borehole locations, soil strata details, Safe Bearing Capacity (SBC), groundwater table, and all other relevant geotechnical parameters required for structural design.

The Employer shall extend necessary assistance for coordination and review; however, approval for implementation of the design and drawings shall be accorded only after recommendations and proof-check certification by the approved Third-Party Scrutiny Agency (IIT/IISc).

t. Structural design and drawing work for Foundation, sub-structure, super structure, precast elements drawings as per relevant IRC, and other codes for the Elevated corridor and Rotary junction shall be prepared. However design and drawings along with launching schemes arrangements for long span to be proof checked by Indian Institute of Technology /Science/National Institute of Technology is mandatory for submission to BSMILE department at the risk and cost of the Successful tenderer for getting approval for execution.

u. After completion of proof checking and scrutiny by approved institutions such as Indian Institute of Technology / Indian Institute of Science / National Institutes of Technology, the Successful Tenderer shall obtain approval of the detailed structural designs and drawings for the Elevated Corridor, elevated rotary structures, second-level elevated structures, portal frames, ramps, approaches, and all associated components from the concerned Engineers of B-SMILE. Thereafter, the Contractor shall prepare and issue Good for Construction (GFC) Drawings, fabrication drawings, launching schemes, working drawings, and all other drawings/documents required for execution, construction, and completion of the Elevated Corridor Project and associated structures in accordance with approved designs and applicable standards.

v. Construction of Elevated corridor including Foundations, Sub Structure, Super Structure for Via Ducts and Intermediate and Obligatory Span, Construction of Reinforced Earth Retaining Walls, RCC Retaining Walls, Backfill between RE Walls / Retaining Walls, Soil Stabilization below RE Panels, Filter Media, Kerbs, Crash Barrier, Crash barrier , noice barrier for elevated corridor as per requirements of B SMILE, Complete Drainage System with Down Take Pipes, Wearing Coat, Water Proofing, Hand Rails to Crash Barriers, Expansion Joints, Bearings, Painting, Deck and Surface Road Illumination, etc. complete in all respects as per MoRT&H / IRC / BIS Specifications.

w. The Scope shall include all the above Works within the Battery Limit. The Battery Limits for the Junctions are indicated in Concept and Alignment plan drawing SSP/DWG/PRJ/2025-26/19-7 for Comprehensive plan of Mysore road and development of Road corridors works within the Battery Limit. The Tender Drawings furnished are only for guidance and understanding of the project concept and scope. The Contractor shall prepare, review, modify, revise, and generate all further detailed engineering drawings, working drawings, plan and profile ,construction drawings, shop drawings, and coordinated utility/drainage drawings as required for execution of the Works in conformity with the approved scope, site conditions, IRC/MoRT&H standards, and directions of the Employer. No additional drawings other than the Tender Drawings shall be provided by the Employer.

x. All such detailed drawings and designs shall be got approved by the Employer / Engineer-in-Charge before commencement of execution

y. The scope also includes construction of a compound wall of not less than 487 m in the project corridor including in Police Quarters.

z. The scope of the Contract shall also include restoration and reconstruction of existing roads damaged during execution of pile foundations, utility works, excavation, movement of construction equipment, or any other construction activities along the Elevated Corridor alignment. Reconstruction shall be carried out for the full extent of the affected and influence areas of such damages, as directed by the Engineer-in-Charge. The restored roadway shall conform to the same or higher specification, composition, pavement crust, and riding quality as the existing road condition prior to commencement of the Works.

aa. The scope of the Contract shall also include construction of slip roads at identified locations along the Project Corridor, as directed by the Engineer-in-Charge of B-SMILE, for an aggregate length of up to 1.2 km. The slip roads shall comprise carriageway of 5.5 m width with Thin White Topping pavement, including a 1.5 m wide buffer/service zone with 80 mm thick paver block finish accommodating Storm Water Drain (SWD) arrangements through NP3 pipes, footpaths of 2 m width with 60 mm thick paver blocks, utility chambers, street lighting, water supply lines, sewerage connections, drainage arrangements, and all associated civil and utility works. The works shall include complete surface finishing, road furniture, kerbs, ducting, utility integration, and all incidental works required for completion in all respects. The exact locations, chainages, and extent of such slip roads shall be decided and instructed by the Engineer-in-Charge during execution of the Project depending upon site requirements and traffic integration needs.

bb. Providing Gantry, Traffic Signals, Traffic Signages, Road Marking and Granite name plate engraver along with necessary Pedestals, Foundation Stone, Stone for Inauguration Ceremony as per Specifications and as per the Approval of the Employer.

cc. Necessary Drainage Arrangement as per Specification. The Levels and Dimension Details for Drainage Arrangement shown in the Tender Drawing are only indicative. The Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study and get the Drawing approved by the Employer before Execution.

dd. Set up of Field Laboratory.

ee. Adequate Street Lighting / Junction Lighting Arrangements as approved by the Employer during Construction.

ff. **Removal / Disposal**: Removal / Disposal of Excess / Disused Earth, Soils, Debris and Materials from the Construction Site. Further, it is the responsibility of the Contractor to identify the Dumping Yard Location and to dispose the Excess / Disused Earth, Soils, Debris and Materials to the same identified Dumping Yard where the same shall not cause Nuisance and shall be acceptable to the Authorities concerned.

gg. Dewatering in Foundation, Trenches, Drainages, wherever required, and pumping out to Locations as directed by the Employer.

hh. All Necessary Safety Measures / Precautions to be adopted at Site as per the Instructions of the Employer.

ii. Providing and maintaining Furnished Site Office for the Supervisory Staff of the Employer and his approved Representative.

jj. Making good the Road Surface as per IRC Standards, which are damaged / worn out during Construction of the Work and restoring the same to the Original Status.

kk. Any other Items of Works, which are not specifically enumerated in the Tender Document, but required for Functioning of all the Infrastructures Developed and as per the Directions of the Employer.

ll. Construction of Architectural Features required for Good Aesthetics of the Infrastructure developed.

mm. Painting with Approved Colour, Shade, Make and Type shall be provided for the various Elements as per the Specifications given in the Tender Document.

nn. The Contractor shall ensure Cleanliness of the Work Area and its surroundings by deploying Man Power for the same. The Contractor shall have to ensure proper Brooming, Cleaning and Washing of Work Area till the Currency of the Contract including Disposal of Sweepage. Nothing extra shall be payable on this account

oo. Cleaning of the Site after Execution and before handing over the Project to the Employer.

pp. The Defect Liability Period (DLP) for the Project shall be Ten (10) Years from the date of issue of Completion Certificate/Provisional Completion Certificate. During the Defect Liability Period, the Contractor shall be responsible for rectification of all defects, deficiencies, settlement, leakages, damages, structural distress, wearing surface failures, expansion joint failures, bearing failures, drainage deficiencies, and all other defects arising out of defective design, workmanship, materials, construction practices, or maintenance obligations at no additional cost to the Employer. For major structural components including portal frames, UHFRC girders, elevated rotary structures, foundations, piers, bearings, and expansion joints, the Contractor shall remain fully responsible for structural performance, safety, durability, and serviceability during the Defect Liability Period.

oo. The detailed scope of work shall be finalized at the time of award of work and the tender document also forms part of the contract document

2.0 Design Criteria

2.1 General and Approach to Work Site

The Site Particulars are shown in the Topographical Map. Refer Tender Drawings no. SSP / DWG / PRJ / 2025-26 / 19-6

2.2 Benchmarks and Setting out of Works

a. The Standard Benchmark and its Reduced Level with reference to which the Work shall be carried out is the GTS Benchmark available nearest to the Site. The Employer does not take the responsibility about the Correctness of the Levels indicated in the Drawings. The Contractor has to establish at least fifteen Benchmarks in the Site of Works with Reduced Levels clearly marked on them. The Contractor shall be solely responsible for the accuracy of the Benchmark Levels and for maintaining the same throughout the Contract Period.

a. The Works shall be set out in accordance with the Drawings approved by the Employer.

b. The Contractor shall be responsible for the True and Proper Setting out of the Works and for the Correctness of the Positions, Levels, Dimensions and Alignments of all Parts of the Works and for the Provision of all Necessary Instruments, Appliances and Labours in connection therewith. The Contractor shall give at least 48 hours' notice to the Employer of his intention to set out or give Levels.

c. If at any time during the Progress of the Work, any Error appears or arises in the Positions, Levels, Dimensions and Alignments of any part of the Work, the Contractor shall at his own expenses and risk, rectify such Errors to the satisfaction of the Employer.

d. The Checking of any setting out of any line or level by the Employer or his approved Representative shall not relieve in any way the Contractor of his responsibility for the Correctness thereof and he shall carefully protect and preserve all the Benchmarks, Site Rails, Pegs and other Things used in the setting out of Works.

f. All Duties concerning Establishment of a Set of Benchmarks, Permanent Stations, Centre Line Pillars, etc. for performing all the Functions necessary at the Commencement and during the Progress of Work till the Physical Completion of all the Items of the Work in question, shall be carried out by the Contractor at his own risk and cost.

e. The Centre Line of the Elevated Corridor and its approaches, Rotary, Piers of Flyovers, Abutments, RE Walls, Surface Level Roads / Slip Roads, Corridor, Electrical room for Railways, Drainage Facilities and the Foundations shall be established by Total Station Equipment and the Centre Line Marks shall be engraved on smoothly finished masonry or concrete pillars of such dimensions and constructed at such intervals and places as may be directed by the Employer or his approved Representative and shall be maintained in proper manner throughout the Period of Construction. The Contractor shall submit a Drawing showing the Alignment of Elevated Corridor, elevated Rotary, Diverging and merging loops, plan of corridor at second levels, connectivity details of corridor with metro double decker flyover, Surface Level Roads / Slip Roads, Corridor and Drainage Facilities within 15 (fifteen) days from the Date of Signing of Agreement.

f. He shall also keep proper Record of such Permanent Benchmarks established denoting therein their Correct Levels.

g. The Work of Establishment of all such Benchmarks shall be carried out by only experienced and skilled staff of the Contractor with the help of precise instruments suitable for this type of Work. The instruments used shall be checked for their accuracy and for permanent adjustments before the commencement of the Work and also at frequent intervals during the progress of the Work.

j. All such Benchmarks established by the Contractor shall be subject to check and approval of the Employer or his approved Representatives. If any Variations noticed in the Work as result of improper establishment or maintenance of such Benchmarks, it shall be rectified at the Contractor's own Risk and Expense.

2.3 General Requirements

In order that the Tenderer's Proposal qualifies as an Alternative Design, it shall generally fulfill the following Requirements.

a. It shall ensure Soundness of the Structure, its Durability and Aesthetics as a whole in harmony with the surroundings. A Report on the Aesthetic Aspect shall be compulsorily in the Technical Bid.

b. It shall ensure Speedy and Practicable Construction.

c. It shall lead to Appreciable Economy in the Design.

d. It shall be accompanied by Detailed Drawings and Detailed Description of Work and Specification of Materials and Items. If called upon, the Tenderer shall explain his Proposal through Power Point Presentation during Tender Evaluation Stage before Opening of Financial Bid.

e. At the time of Detailed Design, the Contractor shall not deviate from the Basic Scheme proposed by him for the purpose of Tender. At the same time, it is mandatory on the part of the Contractor to strictly adhere to all the Geometric Details indicated in the Tender Drawing. The Length of the Ramp could marginally change based on Structural Scheme and Designs after Approval by the Employer.

f. The Alignment of the Elevated corridor, Rotary, Surface Level Road and Drainage Facilities, Electrical, compound wall shown in the Drawings appended with the Tender Document shall be followed by all the Tenderers, and if Any alteration / modifications in alignment plan is proposed by the bidder in the better way resulting with further reduction of the cost of land acquisition and project cost will be subjected to employer approval,

g. The Superstructure shall be designed with minimum feasible expansion joints to ensure smooth, safe, low-noise, and uninterrupted riding quality for vehicular traffic. Expansion joints shall be provided only at structurally essential locations based on design requirements, temperature effects, creep, shrinkage, seismic considerations, and overall structural behaviour.

The Contractor shall adopt modern joint systems such as Modular Strip Seal Expansion Joints, Strip Seal Joints, Link Slab arrangements, Integral/Semi-Integral Deck Systems, or equivalent approved technology conforming to relevant IRC/MORTH specifications to achieve enhanced riding comfort, watertightness, durability, reduced maintenance, and long service life.

Conventional joints causing excessive noise, leakage, vibration, riding discomfort, or high maintenance requirements shall not be permitted unless specifically approved by the Engineer-in-Charge."

h. Only single-pier type structural arrangements shall be adopted for Elevated Rotary Flyovers, unless otherwise approved by the Employer. The pier configuration and geometry shall be architecturally and aesthetically designed to suit the urban environment, with preference given to elliptical, circular, streamlined, or architecturally treated ornamental pier shapes of modern/classical appearance. The design shall ensure structural stability, durability, minimum obstruction to traffic movement below, and visual harmony with surrounding infrastructure. The final selection and approval of pier shape, architectural treatment, and aesthetic

appearance shall rest solely with the Employer, and the decision of the Employer in this regard shall be final and binding on the Contractor.

i. The Tenderer shall note that it is a Requirement for Qualification that the Works warrant that the Structure proposed shall be aesthetically pleasing and easy to maintain considering the Importance of the Work Location.

2.4 Specifications for Design and Codes to be followed

a. The Design, Analysis, Detailing, Proof Checking, Fabrication, Construction, Testing, and Performance Requirements of all Structural and Non-Structural Components of the Works shall conform to the latest applicable editions, amendments, corrections, and revisions of relevant Indian Roads Congress (IRC), Ministry of Road Transport & Highways (MoRTH), Bureau of Indian Standards (BIS/IS Codes), and other applicable national/international standards prevailing as on the date of issue of the Notice Inviting Tender (NIT).

b. The design of the Elevated Corridor, Elevated Loop Structures, Portal Frames, UHFRC / UHPC Structural Components, Precast Segmental Structures, U-Girders, Strutted Box Girders, Foundations, Bearings, Expansion Joints, Pavements, Drainage, and associated works shall generally comply with, but not be limited to, the following Codes, Manuals, Specifications, and Guidelines:

c. Applicable IRC / IS / MoRTH Codes and Standards

- IRC:5 – Standard Specifications and Code of Practice for Road Bridges – Section I: General Features of Design
- IRC:6 – Standard Specifications and Code of Practice for Road Bridges – Section II: Loads and Stresses
- IRC:15 – Standard Specifications and Code of Practice for Construction of Concrete Roads
- IRC:18 – Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned Concrete)
- IRC:21 – Standard Specifications and Code of Practice for Road Bridges
- IRC:22 – Composite Construction (Limit State Design)
- IRC:24 – Standard Specifications and Code of Practice for Steel Road Bridges
- IRC:35 – Code of Practice for Road Markings
- IRC:37 – Guidelines for the Design of Flexible Pavements
- IRC:38 – Guidelines for Design of Horizontal Curves for Highways and Design Tables
- IRC:39 – Standards for Road-Rail Level Crossings
- IRC:44 – Guidelines for Cement Concrete Mix Design for Pavements
- IRC:54 – Recommendations for Lateral and Vertical Clearances at Underpasses for Vehicular Traffic
- IRC:58 – Guidelines for the Design of Plain Jointed Rigid Pavements for Highways
- IRC:65 – Recommended Practice for Traffic Rotaries
- IRC:67 – Code of Practice for Road Signs
- IRC:71 – Guidelines for Design of Road Intersections in Rural Areas
- IRC:78 – Standard Specifications and Code of Practice for Road Bridges – Foundations and Substructure
- IRC:79 – Recommended Practice for Road Delineators
- IRC:83 (Part I, II & III) – Bearings for Road Bridges
- IRC:86 – Geometric Design Standards for Urban Roads in Plains
- IRC:92 – Guidelines for Design of Interchanges in Urban Areas
- IRC:103 – Guidelines for Pedestrian Facilities
- IRC:112 – Code of Practice for Concrete Road Bridges (Limit State Design)
- IRC:SP:19 – Manual for Survey, Investigation and Preparation of Road Projects
- IRC:SP:23 – Vertical Curves for Highways
- IRC:SP:37 – Guidelines for Evaluation of Load Carrying Capacity of Bridges
- IRC:SP:42 – Guidelines on Road Drainage
- IRC:SP:50 – Guidelines on Urban Drainage
- IRC:SP:56 – Guidelines for Steel Pedestrian Bridges
- IRC:SP:57 – Guidelines for Quality Systems for Road Construction
- IRC:SP:84 – Manual of Specifications and Standards for Four Laning of Highways through PPP
- IRC:SP:87 – Manual of Specifications and Standards for Six Laning of Highways through PPP

- IRC:SP:90 – Manual for Grade Separators and Elevated Structures
- IRC:SP:114 – Guidelines for Seismic Design of Road Bridges
- IRC:SP:117 – Specifications for Structural Bearings
- IRC:SP:124 – Guidelines for Use of High Performance Concrete
- MoRTH Specifications for Road and Bridge Works (Latest Edition)
- Indian Railways Bridge Manual, wherever applicable
- IS:456 – Plain and Reinforced Concrete – Code of Practice
- IS:800 – General Construction in Steel – Code of Practice
- IS:1343 – Code of Practice for Prestressed Concrete
- IS:1786 – High Strength Deformed Steel Bars and Wires
- IS:1893 – Criteria for Earthquake Resistant Design of Structures
- IS:2911 (All Parts) – Design and Construction of Pile Foundations
- IS:3370 – Code of Practice for Concrete Structures for Storage of Liquids, wherever applicable
- IS:383 – Specification for Coarse and Fine Aggregates
- IS:10262 – Concrete Mix Proportioning Guidelines
- IS:4926 – Ready Mixed Concrete
- IS:875 – Design Loads (Other than Earthquake)
- IS:16700 – Tall Concrete Structures, wherever applicable
- Relevant ASTM, AASHTO, fib Model Code, PCI, Eurocodes, and international recommendations for UHFRC/UHPC technology wherever Indian standards are not available.

d. Special Provision for UHFRC / UHPC Technology

The design, material specifications, durability requirements, testing procedures, structural behaviour, connection systems, fatigue performance, ductility, serviceability, casting methodology, curing requirements, and quality assurance procedures for Ultra High Fibre Reinforced Concrete (UHFRC/UHPC) components shall conform to internationally accepted practices and guidelines such as fib Model Code, AFGC Recommendations, FHWA Guidelines, PCI Recommendations, or equivalent approved international standards in addition to applicable IRC and IS provisions.

The Contractor shall submit complete design basis reports, material characterization reports, trial mix reports, durability studies, fatigue performance studies, prototype testing results, and proof-check documents for approval by the Employer and Third-Party Proof Consultant prior to commencement of fabrication or construction works involving UHFRC/UHPC technology.

e. In case of conflict between various standards, the order of precedence shall generally be:

1. Specific provisions of the Contract;
2. MoRTH Specifications;
3. IRC Codes and Special Publications;
4. BIS / IS Codes;
5. International Codes/Standards approved by the Employer;
6. Sound Engineering Practice.

The latest revisions/amendments of all applicable codes and standards issued up to the date of submission of bids shall be applicable.

f. For Items not covered by any of the above Standards and Specifications, Sound Engineering Practice and Provisions of Relevant Codes of other Nations shall be referred. In this regard, Decision of the Employer shall be final and binding on the Contractor.

2.5 Order of Precedence in case of Conflict

In Case of Conflict between difference parts of Tender Document, the following Order of Precedence shall prevail.

1. Design Criteria as specified in Tender Document.
2. Instructions to Tenderers.
3. Special Conditions of Contract.
4. General Conditions of Contract.
5. MoRT& H / IRC Specifications.
6. Codes of Practice.

2.6 Soil Investigation to be carried out by the Contractor

The Contractor shall carryout complete Soil Investigation at his own risk and cost. The Boreholes shall be taken at the Final Locations of each Pier of elevated corridor / Abutment, at Selected Points of Retaining Wall, at elevated Portion of Rotary, loop portion and at any other Locations required for the Design of the Works prior to the Commencement of the Work to ascertain the Levels of Rock and its Quality, to obtain SBC at different Depths, Soil Stratification, Ground Water Table, etc. The Termination Level of the Borehole shall be determined by conducting SPT Tests. Three consecutive SPT Tests at an interval of 1.5m each with 'N' values greater than 100 shall be carried out before termination. If rock is encountered, Drilling shall continue upto 3m in rock with Rock Samples taken for Testing. All the Soil / Sub Soil Investigations and its Frequency shall be strictly in accordance with the Relevant Codal Provisions.

a. During Execution of the Work, the Samples from the Bore taken at each Foundation shall be tested and analyzed in the Laboratory approved by the Employer for establishing Design Parameters. Tests such as Standard Penetration Test, Compression and Shear Test on Undisturbed Soil Samples, Pressure Meter Test, Crushing Strength of Rock, California Bearing Ratio (CBR) Test, Plate Load Test, etc. shall be carried out in conformity with the MoRT&H Specifications. The Contractor shall submit the entire Data to the Employer along with his own / Laboratory Recommendations and obtain approval for the Design Parameters. Necessary Interpretation of the Result of Tests shall be furnished to the Employer for scrutiny of Design of Foundations.

b. The Cost of these Tests and Interpretation of the Test Results shall be considered, as incidental to the Main Work and the same shall be included in the Tendered Amount.

c. While checking the Stresses at the Base of Foundations, it shall be ensured that under the Worst Combination of Forces no Tension is permitted. The Safe Bearing Capacity at the Foundation Level shall be verified during Construction so that to ensure that the Stresses imposed on the Foundation Strata are within Permissible Limits.

2.7 Restrictions on Type of Structures

The following Types of Structural Arrangements / Systems shall not be permitted:

a. Structural systems requiring substantial quantities of imported proprietary materials, components, equipment, bearings, cables, fibers, admixtures, or technologies for which continuous foreign supply dependency and foreign exchange arrangements by the Employer would become necessary, unless specifically approved by the Employer.

b. Structural arrangements in which the stability, integrity, redundancy, or serviceability of one or more spans is critically dependent upon the performance or survival of adjacent spans, such that localized failure may result in progressive collapse or disproportionate structural distress.

c. Concrete structural systems incorporating hinges, half-joints, articulations, suspended spans, Gerber systems, or other discontinuity arrangements susceptible to leakage, durability deterioration, fatigue distress, impact loading, excessive maintenance, or riding discomfort.

d. Superstructure arrangements having joints at the tips of long cantilevers, hinge-supported suspended spans, pendulum-type bearings, gap slabs, or similar systems causing vibration, differential deflection, water leakage, riding discomfort, or high maintenance requirements.

e. Transversely continuous wide deck systems supported on structurally independent foundations or support systems without adequate provisions for differential settlement, seismic compatibility, torsional stability, creep, shrinkage, and long-term deformation effects.

f. Pier systems consisting of multiple columns, "Y"-shaped columns, split-column arrangements, hammer-head pier systems with excessive visual bulk, or any configuration causing obstruction to traffic movement, utility corridors, pedestrian movement, or future corridor integration, unless specifically approved by the Employer.

g. Structural systems involving excessive numbers of expansion joints, bearings, or deck discontinuities adversely affecting riding quality, watertightness, durability, noise performance, or long-term maintenance of the Elevated Corridor.

h. Any UHPFRC/UHPC structural system, connection detail, precast jointing arrangement, or construction methodology not supported by adequate analytical studies, prototype testing, fatigue verification, durability assessment, proof checking, and internationally accepted engineering practice.

i. Any structural arrangement resulting in difficult inspection access, complex replacement procedures, excessive lifecycle maintenance requirements, or long-term operational constraints for urban elevated corridor applications.

j. Preference shall be given to continuous, durable, low-maintenance, aesthetically pleasing, and near-jointless structural systems utilizing UHPFRC/UHPC technology with enhanced durability, riding comfort, structural redundancy, and lifecycle performance suitable for dense urban environments.

2.8 Concept and Alignment plan of Elevated Corridor

The concept and alignment plan of elevated corridor with diverging and merging with loop arrangements and approaches connecting to elevated rotary at sirsi circle junction, and extension of proposed flyover up to Nayandahalli Junction elevated corridor with bidirectional and split section, and connecting arrangements of corridor with NICE Junction and with all its approaches integrating with at grade road has been prepared and enclosed as part of tender document. Concept plan with alignment is prepared keeping in view of minimum land acquisition both in private and government properties. The land acquisition plan no SSP/DWG/PRJ/2025-26/19-8 also enclosed to understand the proposed right of way. The successful tenderer shall follow the concept plan for profile design within the proposed right way shown in LA plan without changing the concept. If there is any deviation in concept plan by minimizing the structural length as per the site condition up to the limit of 500m as decided by employer, contractor shall obtain prior approval from B-SMILE before commencement of design under this contract.

The Concept Plan and Alignment Plan for the proposed Elevated Corridor, including diverging and merging arrangements, loop ramps, approach structures, locations of proposed loop elevated structures, integration with the proposed Elevated structure at NICE Junction, and connectivity up to the existing Nayandahalli Elevated Corridor through split carriageway arrangements, and parallel running with Metro/Double-Decker corridor infrastructure along with associated approaches and at-grade road connectivity, have been prepared by the Employer and enclosed as part of the Tender Documents for guidance of the Tenderers.

The Concept Alignment has been developed considering minimum possible land acquisition affecting both private and Government properties while ensuring functional traffic integration, geometric standards, structural feasibility, and future corridor connectivity requirements. The proposed Right of Way (ROW) and land acquisition limits are indicated in the Land Acquisition Plan Drawing No. SSP/DWG/PRJ/2025-26/19-8 enclosed with the Tender Documents.

The Successful Tenderer shall generally adhere to the approved Concept Plan, proposed alignment, profile, second-level connectivity locations, traffic integration arrangements, and Right of Way indicated in the Tender Drawings while carrying out detailed design and preparation of General Arrangement Drawings (GAD). The Contractor shall ensure that the detailed design is developed substantially within the proposed ROW and without altering the basic approved concept, traffic circulation pattern, junction integration philosophy, second-level connectivity arrangements, or corridor integration provisions envisaged in the Concept Plan.

However, based on detailed site investigations, utility constraints, traffic engineering requirements, structural optimization, geometric improvements, construction feasibility, or field conditions encountered during detailed design, minor modifications/deviations in alignment or reduction in structural length up to a maximum cumulative limit of 500 m may be considered, subject to detailed techno-economic evaluation and prior written approval of B-SMILE before commencement of detailed design and execution under this Contract.

2.8.1 Structural Construction Scope for Proposed Elevated Corridor

The scope of this EPC Contract shall include detailed engineering, proof checking, design, procurement, construction, testing, commissioning, and completion of the Proposed Elevated from Sirsi Circle to Nayandahalli on Mysuru Road (Length 5.2kms) in Bengaluru city, including elevated viaducts, loops, ramps, second-level elevated structures, portal frame structures, approaches, utility integration works, drainage arrangements, road restoration works, electrical and illumination works, traffic management systems, and all associated civil, structural, architectural, and urban infrastructure works complete in all respects in accordance with the Conceptual Drawings, Scope of Work, Technical Specifications, applicable IRC/MoRT&H/BIS Standards, and directions of the Engineer-in-Charge.

The proposed elevated corridor system generally comprises UHPFRC based superstructure systems including UHPFRC U-Girders, UHPFRC Strutted Box Girders, and UHPFRC I-Girders of varying carriageway widths including 5.5m, 7.0m, 8.5m, and 20.2m wide elevated carriageways together with associated PSC pier caps, portal frame structures, rotaries, loops, double-level elevated structures, ramps, diaphragms, deck slabs, bearings, crash barriers, wearing course, utility integration systems, and associated substructure/superstructure components along the project corridor.

The chainages, carriageway widths, lengths, span arrangements, structural layouts, and configuration details indicated in the Conceptual Drawings and Abstract Tables are indicative in nature and intended primarily for conceptual planning, tendering, and estimation purposes. The successful EPC Contractor shall carry out detailed surveys, traffic studies, utility mapping, geotechnical investigations, structural analysis, proof checking, and detailed engineering and may suitably optimize the structural arrangement, span configuration, pier positioning, girder configuration, geometry, construction methodology, staging arrangement, and structural systems based on site conditions, traffic requirements, utility constraints, construction feasibility, safety requirements, durability considerations, and approvals from concerned authorities, subject to approval of the Engineer-in-Charge.

The Contractor shall generally adopt structurally efficient and aesthetically slender pier systems suitable for UHPFRC superstructure configurations with minimum obstruction to existing traffic movement, pedestrian circulation, drainage corridors, utilities, and future corridor integration. Pier systems consisting of multiple columns, "Y"-shaped columns, split-column arrangements, hammer-head pier systems with excessive visual bulk, or any configuration causing undue obstruction to traffic movement, utility corridors, pedestrian facilities, drainage arrangements, or future widening requirements shall generally be avoided unless specifically approved by the Engineer-in-Charge due to unavoidable site constraints or structural requirements.

However, notwithstanding the conceptual arrangements shown in the tender drawings, the Contractor shall be permitted to adopt technically suitable alternative structural configurations including cantilever pier systems, portal frame arrangements, single-column piers, balanced structural systems, split carriageway configurations, modified span arrangements, and optimized girder layouts wherever found feasible and advantageous during detailed design, particularly at locations involving split elevated carriageways, loops, rotaries, second-level structures, constrained right of way, utility conflicts, traffic integration zones, or multilevel interchanges, subject to compliance with applicable IRC/MoRT&H standards and approval of the Engineer-in-Charge.

The conceptual structural layouts shown in the Tender Drawings shall therefore be treated as minimum indicative conceptual requirements and shall not restrict the Contractor from proposing technically superior, economical, safer, aesthetically improved, or construction-friendly alternatives during detailed engineering, provided the overall functional requirements, corridor geometry, traffic integration, structural safety, durability, riding quality, maintainability, and project objectives are fully achieved to the satisfaction of the Engineer-in-Charge.

The detailed abstract of proposed elevated structural components, chainages, carriageway widths, lengths, and indicative structural arrangements is provided in the following Schedule/Table forming part of the Tender Document.

Sl. No.	Description	Chainage		Length in Km	Width in m
		From	To		
1	Proposed loop of Single Lane Flyover from existing Balagangadharanatha Swamy Flyover to Kudhure Park (LHS) including merging Tapering length.	0+000	0+968	0.968	8.50
2	Proposed loop of Intermediate Lane from existing Balagangadharanatha Swamy Flyover to Kudhure Park (RHS) including Tapering length of diverging / Merging.	0+000	0+968	0.968	8.50
3	Proposed intermediate Lane from Gopalan Mall to Sirsi Circle (RHS)	0+430	1+968	0.538	7.00
4	Proposed 2 Lane Flyover approach from Kudhure Park to Gopalan Mall (LHS)	0+695	0+895	0.200	8.50
5	Proposed 4 Lane Flyover from Gopalan Mall to Gali Anjaneya Temple to BHEL Junction near Vrishabhavati River Bridge	0+968	2+790	1.822	20.20
6	Proposed tapering intermediate Down Ramp near Bytarayanapura Police Station to BHEL Junction near Vrishabhavati River Bridge	2+405	2+755	0.350	7.00
7	Proposed 2 Lane Flyover from BHEL Junction near Vrishabhavati River Bridge to Existing Nayandahalli Flyover (Indian Oil Petrol Bunk)	2+790	3+450	0.660	8.50
8	Proposed 2 Lane Up Ramp from K.S.R.T.C Bus Depot No. 5 to BHEL Junction near Vrishabhavati River Bridge	0+000	0+270	0.270	8.50
9	Proposed 2 Lane Up ramp Loop from Vijayanagara to Proposed Flyover near Sri Gali Anjaneya Swami Temple Junction	0+000	0+460	0.460	8.50
10	Proposed intermediate loop lane Flyover from BHEL Junction to NICE Road	0+00	0+510	0.510	7.00
			Total length of Elevated Corridor	**6.746**	

2.8.2 At Grade Road Maintenance / Reconstruction & Utility Corridor Works

The scope of this Contract shall also include construction, reconstruction, maintenance, utility integration, drainage improvement, and restoration works for at-grade roads along the Project Corridor affected due to construction of the Elevated Corridor, pile foundations, pile caps, retaining structures, utility shifting, traffic diversion arrangements, movement of construction equipment, and other associated construction activities, as directed by the Engineer-in-Charge.

The works shall include construction of new at-grade/service/slip roads for an approximate cumulative length of 1200m with a typical overall cross-sectional width of 10.5m. The proposed cross section shall generally comprise:

i. 3.5m wide Thin White Topping carriageway with minimum 160mm thick concrete pavement,
ii. 1.5m wide hard shoulder/buffer/utility service zone on either side,
iii. 2.0m wide footpath cum utility corridor on either side,
iv. suitable drainage, utility chambers, utility ducts, landscaping and associated urban infrastructure works.

The carriageway shall be constructed using Thin White Topping pavement over approved base layers conforming to relevant IRC/MoRT&H Specifications. The footpath portions shall be provided with 60mm thick interlocking concrete paver blocks over PCC base/sub-base, while the hard shoulder/buffer utility zones shall be finished with 100mm thick heavy duty interlocking paver blocks over PCC base to facilitate utility maintenance access and service operations.

Water supply pipelines and sewer pipelines shall be provided continuously on both sides of the road corridor to eliminate future cross cutting of carriageways. The typical depth of water supply pipeline shall be about 1.0m below finished ground level and sewer pipeline depth shall generally be about 2.0m below finished level or as approved

by the Engineer-in-Charge based on site conditions and utility requirements.

Storm Water Drainage arrangements shall include NP3 pipes, catch pits, chambers, utility crossings, and associated drainage structures with SWD chambers proposed at intervals of about 20m c/c or as required based on hydraulic design. Utility ducts crossing the roadway shall generally be provided at intervals of about 250m or at locations required for utility integration and service connectivity.

Utility chambers/inspection chambers shall generally be provided at intervals of about 100m or as directed by the Engineer-in-Charge. Provision shall also be made for laying HDPE utility conduits/duct pipes within the utility corridor for future OFC cables, electrical cables, communication lines, smart city infrastructure, and other utility services without disturbing the finished pavement.

The scope shall further include construction of utility corridors, greenery/landscaping provisions, rainwater harvesting arrangements, drainage integration, utility crossings, service connections, and all associated civil and utility infrastructure required for complete functionality of the corridor.

Wherever pile foundations and pile caps are constructed along the median or carriageway portions of the existing corridor, reconstruction/restoration of affected roadway portions adjacent to RE walls, retaining structures, and construction zones shall be carried out for maintaining uninterrupted traffic movement and restoring the original roadway geometry and riding quality.

The scope shall also include restoration of all damaged existing roads along the Project Corridor irrespective of pavement type including:

i. Thin White Topping roads,
ii. Bituminous roads,
iii. footpaths,
iv. medians,
v. kerbs,
vi. utility corridors,
vii. drainage systems,
viii. road markings,
ix. and associated urban infrastructure.

The restoration shall match or improve upon the original pavement composition, crust thickness, riding quality, drainage characteristics, and serviceability of the pre-existing road condition.

The Contractor shall also carry out:

a. desilting and cleaning of existing roadside drains,
b. resetting/reconstruction of drain slabs,
c. repair of damaged drainage structures,
d. reconstruction of damaged kerbs and footpaths,
e. utility reinstatement works,
f. surface restoration works,
g. and all incidental works required for completion of the Project Corridor in all respects.

All at-grade road works, utility integration works, drainage arrangements, chambers, ducts, pavements, and restoration works shall conform to relevant IRC, MoRT&H, BIS, BBMP/B-SMILE Specifications and approved drawings.

2.8.3 Design Data

The design of the Elevated Corridor, approaches, elevated rotary structures, portal frames, and associated works utilizing UHPFRC/UHPC technology shall be based on the latest applicable IRC Codes, BIS/IS Codes, IRC Special Publications, MoRTH Specifications, relevant Ministry Circulars, and approved international standards/guidelines for UHPFRC/UHPC technology wherever corresponding Indian standards are not available.

a. **Location**

The locations of the proposed Elevated Corridor, elevated rotary/interchange structures, second-level elevated structures, ramps, loops, and associated approach arrangements are indicated in the Concept Drawings and Alignment Plans referred to in Clause No. 1.2 of this Section.

b. Type of Bridge

The Elevated Corridor shall generally follow the existing road alignment and shall comprise precast UHPFRC/UHPC superstructure systems with longer spans, generally of 45 m or above wherever feasible. The typical structural arrangement shall consist of PSC pier caps supporting precast UHPFRC U-Girders/Strutted Box Girders, while portal frame locations and second-level structures shall be supported on UHPFRC I-Girders or other approved structural systems suitable for the project requirements.

b. **Road Geometrics**

The geometric design of the Elevated Corridor, Elevated Rotary/Interchange structures, ramps, loops, and approach roads shall conform to the latest applicable provisions of IRC:65 "Recommended Practice for Traffic Rotaries", IRC:92 "Guidelines for the Design of Interchanges in Urban Areas", IRC:86, and other relevant IRC standards. The salient geometric requirements shall generally be as follows:

i. **Vertical Gradient**
The maximum longitudinal gradient for entry ramps, exit ramps, loops, and elevated approach structures shall generally be limited to 5% (1 in 20) or as permitted under relevant IRC provisions considering urban traffic conditions and design requirements.

ii. **Clearances**
The minimum vertical clearance between the finished road level and the soffit level of elevated structures, rotary flyovers, ramps, and associated superstructure components shall be 5.5 m or as specified in the latest applicable IRC/MoRTH standards.

d. **Minimum Viaduct Span**

The minimum span arrangement for the Elevated Corridor, Elevated Rotary structures, and portal frame portions, second-level elevated structures, and associated approaches shall generally not be less than 45m those indicated in Drawing No. SSP/DWG/PRJ/2025-26/19-7 enclosed with the Tender Documents. Any modification to the proposed span configuration shall be subject to detailed structural and geometric justification and prior approval of the Employer.

e. **Obligatory Span**

However, wherever longer or special span arrangements are required beyond the general span configuration along the Elevated Corridor due to site conditions, traffic requirements, road geometry, junction configuration, utility constraints, railway/metro crossing requirements, future integration provisions, navigational clearance, construction feasibility, or any other technical/functional requirements, such spans shall be treated as Obligatory Spans and shall be suitably designed by the Contractor in accordance with applicable standards and project requirements.

The detailed design and span arrangement for such Obligatory Spans shall be subject to review and prior approval of the Employer/Authority before commencement of execution.

f. **Requirement of UHPFRC Strutted Box Girder and UHPFRC I-Girder System**

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The Elevated Corridor and Elevated Rotary structures are proposed with modern precast Ultra High Performance Fibre Reinforced Concrete (UHPFRC/UHPC) Strutted Box Girder and slim-profile UHPFRC I-Girder systems to achieve reduced structural dead load, enhanced durability, longer spans, improved riding quality, minimum maintenance, faster construction, and improved aesthetics suitable for dense urban conditions.

The UHPFRC Strutted Box Girder system proposed for rotary/interchange portions shall be designed considering torsional behaviour, curved geometry effects, seismic forces, fatigue resistance, differential loading, and serviceability requirements. The closed box configuration and strutted arrangement shall provide enhanced torsional stiffness and structural efficiency for curved elevated corridor applications.

In addition, for short straight reaches having wider deck configuration of approximately 20.2 m roadway width, UHPFRC strutted box girder arrangements are also proposed considering structural efficiency, reduced number of supports, improved stability, and enhanced aesthetic appearance.

To facilitate rapid construction and minimize traffic disruption at critical junction locations such as Silk Board Junction and second-level elevated connectivity portions, portal frame arrangements supported on precast slim-profile UHPFRC I-Girders with longer spans generally in the range of 30 m to 40 m are proposed for Portal frame structures. The lightweight characteristics of UHPFRC girders shall enable faster launching, reduced erection time, reduced foundation loads, and improved construction efficiency in congested urban traffic conditions.

The Contractor shall finalize the detailed structural configuration, girder dimensions, prestressing arrangement, diaphragm configuration, bearings, connections, and erection methodology through advanced structural analysis and proof-checked design in accordance with applicable IRC, IS, MoRTH, and approved international standards for UHPFRC/UHPC technology.

For elevated rotary portions having significant curvature, suitable bearing systems such as POT-PTFE, spherical bearings, or equivalent approved systems shall be adopted considering torsional restraint, rotational requirements, seismic behaviour, durability, and long-term maintenance performance.

The preliminary conceptual arrangement of the UHPFRC Strutted Box Girder and UHPFRC I-Girder system is indicated in Drawing Nos. SSP/DWG/PRJ/2025-26/18-10-1, SSP/DWG/PRJ/2025-26/19-10-2 enclosed.

2.8.4 Description of Work and Elevated Corridor Provisions for Alternative Proposals

a. Alignment and Location

The Alignment, Longitudinal Profile, obligatory spans, second-level connectivity locations, elevated rotary arrangements, portal frame portions, ramp connections, loop arrangements, and other mandatory structural provisions for the proposed Elevated Corridor shall generally conform to the Concept Drawings and Alignment Plans indicated in Drawing Nos SSP/DWG/PRJ/2025-26/19-7 enclosed. Any modification/deviation proposed by the Contractor shall require prior review and approval of the Employer.

b. Layout of Elevated Corridor

The layout and geometric configuration of the Elevated Corridor, elevated rotary/interchange structures, ramps, approaches, loops, second-level structures, and associated elevated arrangements shall satisfy the following criteria in addition to requirements indicated in the Drawings and Supplementary Data:

i. Minimum vertical and horizontal clearances as per applicable IRC/MoRTH standards.

ii. Adequate open span lengths considering traffic movement below, junction clearances, utility corridors, aesthetics, visibility, and future integration requirements.

iii. Compliance with permissible ruling gradients and geometric standards for urban elevated corridors.

iv. Minimum lengths of summit and valley curves shall conform to IRC requirements for riding comfort, visibility, drainage, and operational safety.

v. Provision for integration with existing flyovers, metro/double-decker corridors, at-grade roads, slip roads, and future corridor connectivity.

vi. Any other criteria, mandatory provisions, or structural requirements indicated in the Concept Drawings and Tender Documents.

c. **Road Level and Roadway Particulars**

i. The proposed roadway configuration, carriageway widths, lane arrangements, rotary geometry, split carriageway sections, ramps, loops, utility corridors, and structural widths shall generally conform to Concept plan and cross sectional drawings enclosed with the Tender Documents. The Tender Drawings are only conceptual and indicative in nature, intended solely to represent the overall scope of work, typical sections, structural configuration, and project requirements.
Any additional engineering drawings, detailed site investigations, utility mapping, existing road geometry details with plan and profile, traffic management drawings, construction staging drawings, temporary works drawings, and other design details required for execution of the Project shall be generated by the Tenderer at his own cost based on actual site conditions and scope requirements, and wherever required, the same shall be submitted to the Employer for review/approval. No drawings other than those included in the Tender Documents shall be made available by the Employer.

ii. The vertical profile of the finished riding surface including deck slab, wearing course, ramps, and transition portions shall be designed as smooth continuous curves ensuring riding comfort, drainage, safety, and operational efficiency. Vertical and horizontal curves shall be designed in accordance with applicable IRC standards and shall be subject to approval of the Employer. The design speed for the Elevated Corridor and associated structures shall generally be 40 km/hr unless otherwise specified. Suitable camber, widening at curves, transitions, and super elevation shall be provided wherever required as per IRC provisions. Super elevation requirements for elevated rotary portions shall be designed considering traffic speed, operational safety, and geometric constraints.

2.8.5 Design Loads

a. Live Load

The Elevated Corridor, Elevated Rotary structures, ramps, portal frames, second-level elevated structures, PSC Pier Caps, and UHPFRC/UHPC superstructure systems including U-Girders, I-Girders, and Strutted Box Girders shall be designed for live loads in accordance with the latest edition of IRC:6 and other relevant IRC/MoRTH provisions applicable for urban elevated corridors and interchange structures.

b. Wind Forces

Wind loads shall be considered in accordance with the latest edition of IRC:6, IS:875, and other relevant standards. Wind effects on the superstructure, substructure, portal frames, barriers, noise barriers (if any), lighting poles, signage gantries, utilities, and all exposed structural elements shall be duly considered in the design. Wind loads on lighting poles generally of 9 m height at approximately 25 m spacing or as per approved layout shall also be considered.

c. Seismic Forces

The Elevated Corridor and associated structures shall be designed for seismic forces in accordance with the latest provisions of IRC:6, IS:1893, IRC:SP:114, and other applicable seismic design standards considering the importance and urban criticality of the structure.

d. Earth Pressure

i. Soil properties for embankments, retaining structures, approach portions, reinforced earth structures, and foundations shall conform to MoRTH Specifications and approved geotechnical investigation reports. For preliminary tender purposes, embankment soil properties may generally be considered with dry density of 1.85 t/cum, saturated density of 2.0 t/cum, angle of internal friction (Φ) = 30°, and cohesion (C) = 0, unless otherwise specified.

ii. Saturated density of backfill material, not less than 2.0 t/cum or as determined through approved geotechnical investigations, shall be considered for computation of active earth pressure and stability analysis.

e. Temperature Effects

i. The design of UHPFRC/UHPC superstructures, PSC pier caps, portal frames, bearings, expansion joints, and associated structural components shall consider temperature effects in accordance with IRC:6, IRC:112, and relevant international recommendations applicable to UHPFRC/UHPC structures. For preliminary design purposes, the temperature variation ("t") may generally be considered as ±17°C or as required under applicable standards and local climatic conditions.

ii. Temperature gradients across deck depth, differential thermal effects, creep, shrinkage, prestress losses, restraint effects, and long-term deformation characteristics of UHPFRC/UHPC and PSC components shall be considered appropriately in the structural analysis and design. Suitable reduced modulus values accounting for creep and long-term thermal strain effects may be adopted in accordance with applicable IRC/IS provisions and approved engineering practice.

2.8.6 Durability

a. Minimum Grade of Concrete shall be as below.

PCC for Levelling Course	M15
RCC for Open Foundation, and Sub Structure and Super Structure	M35
RCC for Super Structure	M45
RCC for Pile and Pile Cap	M35
Prestressed Concrete	M45

b. **Minimum Cement Content, Diameter of Bar and Cover Requirements**

For Plain Cement Concrete (PCC), Reinforced Cement Concrete (RCC) and Pre Stressed Concrete (PSC), the Value given below regarding Minimum Cement Content and Maximum Water Cement Ratio shall be followed.

Plain Concrete		**RCC / PSC**	
Minimum Cement Content Kg / cum.	Maximum Water Cement Ratio	Minimum Cement Content Kg / cum.	Maximum Water Cement Ratio
240	**0.45**	**420/440**	**0.45 / 0.40**

c. The Minimum Nominal Diameter of Reinforcement shall be 8mm.

d. The Minimum Clear Cover to Reinforcement for all Grades of Concrete shall be as below.

Structural Element	**Clear Cover**
Slab	40mm
Web / Column	40mm
Footing / Raft slab	75mm
Cable Duct	75mm
Pile Foundation	75mm

2.8.7 Foundation

Foundation Planning and Design:

Foundation system for the proposed Elevated Corridor, elevated rotary/interchange structures, portal frame locations, second-level carriageway portions, RE wall approaches, and associated structures along old madras road to the Silk Board corridor shall be designed based on detailed geotechnical investigations, utility constraints, traffic management requirements, construction feasibility, and site conditions. In general, deep foundations such as bored cast-in-situ piles are proposed considering dense urban conditions, existing utilities, restricted working space, multi-level structures, and requirement of longer span UHPFRC superstructures. However, wherever feasible and technically suitable based on bearing capacity, site constraints, and approval of the Employer, open foundations may also be considered for approach structures and ancillary works. The Contractor shall optimize the foundation system to suit the approved concept alignment, construction methodology, safety requirements, and project completion schedule.

a. **General**

The proposed Elevated Corridor alignment from Old Madras Road to Silk Board Junction traverses through dense urban corridors having mixed strata conditions comprising stiff to hard non-cohesive soil with localized rock formations at varying depths. Based on the preliminary geotechnical investigations carried out at Trial Bore Holes No. 1 to 10, the anticipated founding depth for pile foundations generally varies from about 16 m to 25 m below ground level for 1200 mm diameter bored cast-in-situ piles, with estimated safe axial load carrying capacity of about 580 Tons per pile. The allowable Safe Bearing Capacity (SBC) of soil strata for open foundation locations is generally observed in the range of 200 T/sq.m to 250 T/sq.m subject to detailed site-specific investigations.

Considering the dense urban traffic conditions, restricted working space, utility congestion, multi-level elevated structures, portal frame locations, elevated rotary/interchange portions, second-level carriageway integration, and requirement of longer span UHPFRC superstructures, deep foundations are generally proposed for the Project. However, wherever feasible and technically suitable based on detailed geotechnical investigations, site constraints, structural requirements, and approval of the Employer, open foundations may also be considered for approach structures and ancillary portions.

The pile foundations shall generally be of bored cast-in-situ type conforming to relevant provisions of IS:2911 and other applicable IRC/BIS standards, including socketing into suitable hard strata/rock wherever required based on design and investigation results. Final foundation system, founding levels, pile capacities, and design parameters shall be established by the Contractor based on detailed geotechnical investigations and approved design calculations.

b. **Quality of Concrete for Piles, Pile Caps and Foundation Components:**

The minimum grade of concrete for bored cast-in-situ pile foundations shall be M35 or higher as required by design, conforming to relevant IRC, IS and MoRTH Specifications. Concrete for pile caps, foundations, PSC pier caps, piers and other substructure components shall be of grades specified in the approved design and Contract Documents. Minimum cement content, water-cement ratio, durability requirements, admixtures, workability, chloride permeability, curing and quality control parameters shall conform to applicable IRC/BIS provisions and approved mix designs. Coarse aggregates, fine aggregates, water, cementitious materials, admixtures and all other constituents of concrete shall comply with relevant Specifications and approved quality standards for durable urban elevated corridor structures.

c. **Length and Diameter of Piles:**

The pile foundations for the Elevated Corridor, elevated rotary/interchange structures, portal frames, second-level carriageway portions and associated structures shall generally consist of bored cast-in-situ reinforced concrete piles conforming to IRC:78, IS:2911 (All Parts), relevant IRC/BIS Codes and approved design requirements. The piles shall be designed based on detailed geotechnical investigations, structural loading, settlement criteria, lateral load requirements and site conditions. The proposed pile diameter shall generally be 1200 mm for main corridor structures, elevated rotary/interchange portions, portal frame structures and wider carriageway sections, whereas 1000 mm diameter piles may be considered for narrower carriageway portions such as 8.5 m wide corridors and approach structures, or as required by approved design and site conditions.

Piles shall derive load carrying capacity through end bearing and/or skin friction depending upon the soil strata encountered and design assumptions established through detailed investigations. Wherever required, piles shall be socketed into hard strata/rock in accordance with IRC:78 and IS:2911 recommendations. Presence of hard strata/rock shall be established through bore log data, SPT values, rock core recovery, chiselling records and other approved geotechnical investigation methods. Necessary tests including initial load tests, routine load tests, integrity tests and other quality assurance tests shall be carried out as per relevant Codes and Specifications at no extra cost to the Employer.

Temporary casing, bentonite/polymer slurry stabilization, chiselling tools, rock augers, casing oscillators and other suitable boring arrangements shall be deployed wherever required to maintain stability of boreholes and to facilitate safe execution in dense urban conditions. The minimum embedment/socket length, founding level

and termination criteria of piles shall be finalized based on detailed design calculations, test results, geotechnical recommendations and approval of the Employer/Authority Engineer.

Pile Diameters: Piles of minimum 1000mm dia or above shall be used for the Flyovers.

i. **Boring**
Boring Equipment and Accessories shall generally conform to IS: 2911 (Part I / Section – 2). Boring may be done by either Rotary or Percussion Equipment. In case of Unstable Soils, the Boring Tools used shall be such that Suction Efforts are minimised. Stabilization of the Sides of the Boreholes shall be done by the use of Bentonite Slurry or Casing. The Size of the Cutting Tool shall not be less than the Diameter of the Pile by more than 75 mm.

ii. **Drilling Mud**
The Drilling Mud shall be used at least from the Level of Subsoil Water or from the Level of Bottom of Guide Casing depending upon the Site Conditions and the Hole shall then be always kept almost full with the suspension, which shall preferably be kept in motion. The Density and Composition of the Suspension shall be such that to suit the Requirements of the Ground Condition and to maintain the Fine Materials from the Boring in Suspension. A 5% Bentonite Suspension would be generally suitable and its quality shall conform to the Specification given in Appendix A of IS: 2911 (Part I / Section 2).

iii. **Cleaning of Borehole Bottom**
The Bottom of the Hole shall be cleaned very carefully before Concreting Work is taken up. The Cleaning of the Hole shall be ensured by careful operation either by Flushing with the Fresh Drilling Mud through the bottom of the hole or by Air Lifting Process. To lift the Spoil at Founding Level before Concreting, Borehole shall be agitated by jetting with Fresh Drilling Mud with relatively higher pressure than that used during Boring or Air through Tremie Pipe. While boring by use of Drilling Mud, the Specific Gravity of the Mud Suspension in the vicinity of the bottom of Borehole shall be determined at Suitable Interval and Record. Consistency of the Drilling Mud Suspension shall be controlled throughout the Boring and during Concreting Operation, in order to keep the Hole stabilised as well as to avoid Settlement of the Mud.

d. **Founding Level for Piers / Abutments**
The Technical Proposal / GAD shall indicate Founding Level at each Pier / Abutment Location. The Turnkey offer shall include for possibility of Cost of Variation if any between the Actual Founding Level and the Founding Level considered for the Purpose of Bidding. No Extra Payment shall be made in this regard after Finalization of the Turnkey Contract Price.

e. **Ramp / Retaining Walls**
The Solid Ramp Portion of the Flyovers shall be constructed with Reinforced Earth Retaining Structure or RC Retaining Wall designed aesthetically. The Abutments and Returns shall be designed for Live Load Surcharge equivalent to Earth Fill of 1.2m height respectively. The Minimum Density of Filling for Calculations of Surcharge Pressure shall be 2 t / cum. The Surcharge Effect shall be considered for the Purpose of Evaluating Earth Pressure only and not for Vertical Loads.

f. **Pile Foundation**

i. Only Bored Cast – in – Situ Piles shall be accepted.

ii. The Pile Foundations shall be designed as per the Requirements of IS: 2911 (Part I/Section 2) (Latest Edition).

iii. The Contractor shall carry out the Initial Pile Load Test at his own expense. The Design Capacity assumed for the Piles shall be verified by the Initial Load Testing of Test Piles in non working areas, in the vicinity of the Flyovers Site. These Piles shall be tested for 2.5 times the Design Load. Additional Two Piles for each diameter, which are actually going to be used for Piers and Abutments, shall be tested for 1.5 times the Design Load. Minimum Number of both these Tests to be carried out for each Diameter of Pile shall be two (2) each. The Contractor shall carry out the Pile Load Tests as per the Amendments to Existing Methodology of Pile Load Testing by the Task Force for Quality Assurance in Public Construction dated 22 – 10 – 2011 and IS: 2911 (Part 4).

iv. Annular Piles filled or unfilled shall not be accepted.

v. Design with Single Row of Piles shall not be accepted.

vi. Design shall ensure that no Pile is subjected to Tension.

vii. Concreting shall be done, by Tremie Method after ensuring proper Tip Zone Cleaning by Flushing only.

viii. The Top of Concrete in Pile shall be brought above the cut off level by minimum 750mm to permit removal of all Laitance and Weak Concrete before Pile Cap is laid.

a. Open Foundation

Open Foundation may be provided where the foundations can be lied in a stratum which is in erodible and where the strata is hard at shorter depth.

Excavation should be done in such a way that surrounding soil can stand by itself by suitable sloping the sides. When the excavation has to be deep or when the side slopes are not stable, suitable shoring may be provided from top using timber planks, walling piece and struts.

2.8.8 Substructure

a. Dimensions and Structural Requirements

i. The dimensions of substructure elements such as piers, pier caps, portal frame columns, cross beams, pedestals, abutments and retaining structures shall be designed based on structural requirements, durability considerations, architectural appearance, construction methodology and relevant IRC/BIS provisions. However, no structural element thickness shall generally be less than 300 mm or as required by approved design.

ii. Piers for the Elevated Corridor shall generally be of solid RCC/PSC type with aesthetically pleasing shapes such as elliptical, circular, streamlined or architectural forms as approved by the Employer. Portal frame substructures shall be adopted at specified second-level and special crossing locations as indicated in the Concept Plan and approved drawings.

iii. PSC pier caps, hammer head pier caps, portal frame cross beams and bearing pedestals shall be designed to suit UHPFRC U-Girders, I-Girders and strutted box girders, considering erection methodology, future maintenance accessibility, structural stability and serviceability requirements. The height of pedestals supporting bearings shall generally be minimized consistent with design requirements.

b. Layout and Design Requirements

i. Bearings shall preferably be supported directly over pier stems/pier caps and shall be designed considering longitudinal, transverse, torsional and seismic effects arising from curved alignment portions, elevated rotary/interchange structures, portal frame arrangements and second-level carriageway integration.

ii. Dead man anchors, friction slabs or similar arrangements behind abutments for relieving moments shall not be permitted unless specifically approved by the Employer based on detailed design justification.

iii. Adequate provisions shall be made in the design for inspection, maintenance, replacement of bearings, jacking arrangements and future accessibility to all structural components. Locations of lifting/jacking arrangements shall be clearly indicated in drawings and permanently marked on the structure.

iv. Tall piers, portal frame columns and slender substructure elements shall be checked for stability, deflection, vibration, second-order effects and serviceability under all applicable loads including wind, seismic, braking, temperature, erection and construction stage loads in accordance with relevant IRC/BIS Codes.

2.8.9 Superstructure

a. General

The superstructure for the proposed Elevated Corridor shall generally consist of precast/prestressed UHPFRC/UHPC U-Girders, strutted box girders and I-Girders supported over RCC/PSC pier caps, portal frame structures and suitable bearing arrangements. The superstructure system shall be designed considering speed of construction, reduced self-

weight, minimum maintenance, durability, traffic management requirements, curved alignments, elevated rotary/interchange geometry, second-level integration and construction feasibility in dense urban conditions.

b. Strutted Box Girder – 20.2 m Wide Carriageway

For wider carriageway portions including 20.2 m, precast/prestressed UHPFRC strutted box girder sections are proposed. The typical overall depth of strutted box girder shall be about 2.25 m with bottom width about 6.29 m and top width about 6.1 m. The bottom slab thickness shall generally be about 275 mm and web thickness about 225 mm or as required by approved design. Internal cross struts of approximately 100 mm thickness and external projected struts of about 250 mm thickness integrated with deck slab arrangement shall be provided to improve torsional rigidity, transverse stability and structural efficiency. End diaphragms and intermediate diaphragms shall be provided as required by design.

c. UHPFRC U-Girders – 8.5 m Carriageway

For 8.5 m wide carriageway portions, single precast/prestressed UHPFRC U-Girder sections are proposed. The typical girder section shall have bottom width about 2.95 m, overall depth about 2.20 m, web thickness about 200 mm and top width about 4.0 m or as required by approved design. A 50 mm thick UHPFRC plate shall be provided to support the deck slab of approximately 280 mm thickness. Prestressing shall generally be carried out using 15.2 mm diameter low relaxation HT strands conforming to relevant IRC/IS Specifications. Suitable end diaphragms, intermediate diaphragms and structural stiffening arrangements shall be provided.

d. UHPFRC I-Girders for Portal Frame Structures

UHPFRC prestressed I-Girders are proposed for portal frame structures, second-level carriageway portions and special crossing locations to facilitate rapid construction under restricted urban traffic conditions. The typical girder configurations shall generally be as follows or as modified by approved design:

i. For 20 m Span:

Overall girder depth about 650 mm, top flange width about 500 mm with flange thickness about 135 mm comprising 100 mm straight portion and 35 mm tapered portion. Web thickness shall generally be about 125 mm with web depth about 290 mm. Bottom flange shall generally have top width about 125 mm, bottom width about 450 mm and thickness about 225 mm comprising 150 mm straight portion and 75 mm tapered portion.

ii. For 30 m to 35 m Span:

Overall girder depth about 1250 mm, top flange width about 700 mm with flange thickness about 135 mm comprising 100 mm straight portion and 35 mm tapered portion. Web thickness shall generally be about 125 mm with web depth about 890 mm. Bottom flange shall generally have top width about 125 mm, bottom width about 600 mm and thickness about 225 mm comprising 150 mm straight portion and 75 mm tapered portion.

iii. For 40 m to 45 m Span:

Overall girder depth about 1400 mm, top flange width about 600 mm with flange thickness about 135 mm comprising 100 mm straight portion and 35 mm tapered portion. Web thickness shall generally be about 125 mm with web depth about 1040 mm. Bottom flange shall generally have top width about 125 mm, bottom width about 650 mm and thickness about 225 mm comprising 150 mm straight portion and 75 mm tapered portion.

The above girder sections are indicative conceptual configurations prepared for tender purposes. Final dimensions, prestressing requirements, reinforcement detailing, diaphragms and structural arrangements shall be established through detailed design, proof checking and approval process.

e. Prestressing and Structural Requirements

i. Prestressing strands shall generally consist of low relaxation HT strands of 15.2 mm diameter conforming to IS:14268 and relevant IRC provisions unless otherwise approved by the Employer.

ii. The superstructure shall be analyzed and designed for dead loads, live loads, impact, braking forces, temperature effects, creep, shrinkage, wind, seismic effects, torsion, construction stage loads and differential settlements in accordance with IRC:6, IRC:18, IRC:112 and other applicable Codes.

iii. The superstructure system shall adequately cater for torsional effects arising from curved alignments, elevated

rotary/interchange portions, portal frame structures and second-level integration arrangements.

iv. End diaphragms, intermediate diaphragms, cross beams, bearings and expansion joint systems shall be designed considering structural integrity, durability, maintenance accessibility and erection methodology.

f. Precast Construction and Erection

i. Precast UHPFRC/UHPC girders and structural elements shall be manufactured in approved casting yards under controlled quality conditions with suitable moulds, stressing beds, curing systems, handling arrangements and quality assurance procedures.

ii. All girders and precast elements shall be designed for handling, transportation, lifting, launching and erection stresses. Suitable lifting points, orientation marks and identification systems shall be clearly indicated.

iii. Launching and erection methodology shall be planned considering restricted urban working conditions, traffic management requirements, utility constraints, railway crossings, metro integration and safety provisions.

iv. The Contractor shall establish suitable quality control procedures for UHPFRC/UHPC production, casting, curing, prestressing, testing, transportation and erection conforming to approved specifications and recommendations of specialized consultants/proof checking agencies.

2.8.10 Bearings below Superstructure

Bearings for the Elevated Corridor superstructure shall be designed and provided to suit UHPFRC/UHPC U-Girders, strutted box girders, I-Girders, portal frame structures, elevated rotary/interchange portions and second-level carriageway arrangements. Bearings shall generally be located below diaphragms, cross beams or designated support zones and shall preferably remain within the external limits of pier caps, portal frames or supporting substructure elements.

a. Type of Bearings

The type of bearings shall be selected based on span length, structural configuration, torsional effects, seismic considerations, curvature of alignment, rotational requirements and approved design criteria. The generally proposed bearing arrangements are as follows:

Span Range / Structural Arrangement	Proposed Bearing Type
Effective spans up to about 18 m	Elastomeric Bearings
Effective spans above 18 m Curved spans, elevated rotary/interchange	POT/PTFE Bearings or Spherical Bearings
Structures and torsion-sensitive locations	Spherical Bearings / Guided POT-PTFE Bearings
Portal frame and special integral arrangements	Bearings/Integral arrangements as per approved design

b. Accessibility and Maintenance

All bearings shall be properly accessible for inspection, maintenance, replacement and future monitoring without affecting traffic safety and structural stability.

c. Provision for Future Replacement

The design of superstructure, pier caps and bearing arrangements shall include suitable provisions for lifting/jacking of superstructure for future replacement, maintenance or inspection of bearings. Necessary jacking locations and lifting arrangements shall be clearly indicated in approved drawings.

d. Inspection and Quality Control

All bearings shall conform to relevant IRC Codes, MoRTH Specifications and applicable BIS standards. Bearings shall be manufactured, tested and inspected by approved agencies/manufacturers. Necessary quality certificates, inspection reports and test certificates shall be submitted by the Contractor at no extra cost to the Employer.

e. Structural Requirements

The dimensions of bearing plates, seating arrangements and contact surfaces shall be designed to safely transfer all vertical, longitudinal, transverse, torsional and seismic forces from the superstructure to substructure with adequate edge distance, stability and durability requirements as per approved design and relevant Codes

2.8.11 Expansion Joints

The Superstructure shall be designed with minimum feasible expansion joints to ensure smooth, safe, low-noise and uninterrupted riding quality for vehicular traffic. Expansion joints shall be provided only at structurally essential locations considering span arrangement, temperature effects, creep, shrinkage, seismic effects, staged construction requirements and overall structural behaviour of the Elevated Corridor, elevated rotary/interchange structures and second-level carriageway portions.

Modern joint systems such as Modular Strip Seal Expansion Joints, Strip Seal Expansion Joints, Link Slab arrangements, Integral/Semi-Integral Deck Systems, or equivalent approved technologies conforming to relevant IRC Codes and MoRTH Specifications shall be adopted to achieve improved riding comfort, watertightness, durability, reduced vibration and noise levels, minimum maintenance requirements and enhanced service life.

Conventional expansion joints causing excessive noise, leakage, vibration, riding discomfort or frequent maintenance shall not be permitted unless specifically approved by the Employer/Engineer-in-Charge.

Elastomeric Strip Seal Expansion Joints conforming to Clause 2607 of MoRTH Specifications or approved equivalent systems shall generally be adopted wherever expansion joints are required. The Contractor shall submit detailed design calculations indicating adequacy of movement range, gap requirements, temperature movement, rotational capacity and structural compatibility of the selected joint system along with manufacturer's technical details, installation methodology and maintenance requirements for approval.

Installation of expansion joints shall be carried out under the supervision of the manufacturer's authorized engineer/specialist including thermal presetting, alignment control, watertight sealing and quality assurance procedures wherever required.

2.8.12 Crash Barrier.

Concrete crash barriers shall conform to relevant provisions of IRC:5, IRC:112, Clause 809 of MoRTH Specifications and applicable Ministry Circulars including MoRT&H Circular No. RW/NH-33022/1/94-DO dated 24.06.1994. The crash barrier section proposed in the Project is generally based on IRC standard profile with an approximate concrete sectional area of 0.25 Sq.m per running metre or as required by approved structural design.

The Contractor may propose equivalent or improved crash barrier systems conforming to relevant IRC/MoRTH standards subject to approval of the Employer. Suitable hand railing arrangement using 50 mm diameter MS tube or approved equivalent section shall be provided above the crash barrier wherever required for safety, maintenance access and pedestrian protection. Connections shall preferably be bolted or mechanically fixed and field welding shall generally not be permitted unless specifically approved.

Crash barriers shall be designed considering vehicular impact loads, durability, riding safety, aesthetics, drainage requirements and integration with lighting poles, noise barriers, utility provisions and elevated corridor architectural features. Provision for Employer's emblem/logo shall be incorporated at suitable intervals as approved by the Employer.

2.8.13 Drainage

Drainage of Storm Water collected on the Rotary Flyovers/Elevated Structure is essentially based on
IRC: SP: 42 "Guidelines on Road Drainage"
IRC: SP: 50 "Guidelines on Urban Drainage"

The Drainage Spouts shall conform to Clause 2705 of MoRT&H Specifications. The Tenderer shall indicate the Drainage Spouts and its Disposal to natural Storm Water Drain in the Drawings submitted with the Technical Bid.

The Drainage Spouts shall be connected to a Cast Iron Runner Pipe of diameter not less than 150mm and taken down by Down Take Pipes of suitable diameter through the Pier or at Approved Locations. These Pipes shall be connected to Longitudinal Drains below Surface and the Water finally being disposed off into natural Storm Water Drain using appropriately designed RCC Box Culverts for Crossings.

At Ground Level, Catch Water Drain with GI Gratings at Top shall be provided at each end of the Flyovers. Drainage of Water collected at the Deck Level shall be effectively conveyed to Tertiary Drains at Ground Level through Appropriate Box Culverts across Surface Level Roads. The Drains shall be connected to the nearest natural Storm Water Drain. The Turnkey Cost shall include for all these Items.

The entire System including all Arrangements / Details shall be included in the Cost.

2.8.14 Wearing Coat

A 50 mm thick Stone Matrix Asphalt (SMA) wearing course shall be provided over a 3 mm thick waterproofing membrane system on the deck slab/superstructure to ensure durable, skid-resistant, smooth and waterproof riding surface for vehicular traffic. The waterproofing membrane and SMA wearing course shall conform to relevant provisions of MoRTH Specifications, IRC guidelines and approved material specifications.

The wearing course system shall be designed and executed to provide proper drainage, riding comfort, crack resistance, durability, prevention of water ingress into structural components and minimum maintenance requirements under dense urban traffic conditions.

The cross sections, carriageway widths, deck arrangements and wearing course details indicated in Drawing Nos. SSP/DWG/PRJ/2025-26/18-10-1 to 8 for the Elevated Corridor, elevated rotary/interchange structures, portal frame portions and associated approaches shall be generally adhered to unless otherwise modified and approved during detailed design.

2.8.15 Approach Slab

The Approach Slab shall conform to Clause 2704 of MoRT&H Standard Specifications for Road and Bridge Works (Latest Edition).

2.8.16 Electrical Works and Illumination

The Contractor shall include in the EPC scope the complete design, supply, installation, testing and commissioning of street lighting, architectural illumination, electrical utility integration and associated electrical works for the Elevated Corridor, elevated rotary/interchange structures, second-level carriageway portions, portal frame structures, under-deck areas, approach roads and junction improvement locations.

The lighting system shall be designed in accordance with relevant IS Codes, IRC Guidelines, CEA Regulations, BESCOM requirements and applicable MoRTH Specifications. The Contractor shall submit detailed lighting layouts, illumination calculations, power load requirements, feeder arrangements, cable routing, earthing systems and energy-efficient lighting proposals along with detailed design submissions for approval.

LED-based energy efficient lighting systems with suitable poles, brackets, control panels, junction boxes, cabling, earthing, lightning protection and maintenance access arrangements shall generally be adopted. The illumination level shall be designed to achieve safe and uniform visibility for vehicular movement, pedestrian safety, traffic guidance and under-structure usability, generally maintaining average illumination levels of about 40 lux or as required by relevant standards and approved design criteria.

The Contractor shall also coordinate with all concerned utility agencies for power supply arrangements, shifting/protection of existing electrical utilities and integration with existing street lighting systems within the project limits.

2.8.17 Integrity Test

Low Strain Integrity Test shall be carried out for all the Piles in conformation to ASTM D 5882 from an Empanelled Consultant in the Ministry of Shipping, Road, Transport & Highways. The Tenderer shall include the Cost of Conducting this Test in his EPC Tender.

2.8.18 Painting and Protective Coating System

Protective painting/coating systems with approved colour, shade, make and specifications shall be provided for various structural and architectural elements of the Elevated Corridor Project to ensure durability, aesthetics, weather resistance and minimum maintenance under urban environmental conditions.

Sl. No.	Structural Element	Protective Coating / Painting System
1	UHPFRC/UHPC Girders, PSC Pier Caps, Piers, Portal Frames, Viaducts, RE Wall Panels and RCC/PSC Structural Components	Anti-carbonation protective coating/approved concrete protection system conforming to relevant IRC/MoRTH Specifications and approved manufacturer recommendations**.**
2	Structural steel inserts, embedded steel components, utility brackets, railings, ladders and exposed fabricated steel items	Two coats of approved epoxy paint over compatible zinc-rich/epoxy primer system after proper surface preparation.
3	Kerbs, medians, parapets, footpaths, utility ducts, guard rails, grills and other miscellaneous MS items	Two coats of approved enamel/epoxy paint over suitable primer system as approved by the Engineer-in-Charge.
4	MS Hand Rails over crash barriers and maintenance walkways	Two coats of epoxy/polyurethane paint over compatible primer after proper surface cleaning and approved surface preparation method.
5	Exposed surfaces requiring architectural/aesthetic treatment	Texture coating, anti-graffiti coating, decorative finish or approved architectural protective system as specified in approved drawings/design documents.

All painting and protective coating works shall conform to relevant IRC, MoRTH, IS Specifications and approved quality standards. Surface preparation, curing, application methodology, dry film thickness, durability requirements and quality assurance procedures shall be carried out strictly as per approved manufacturer specifications and project requirements.

2.8.19 Specialized Agency for Design and Manufacture of UHPFRC Girders

Considering the specialized nature of Ultra-High Performance Fibre Reinforced Concrete (UHPFRC) girders proposed for the elevated corridor, the successful Contractor shall engage a competent and experienced specialized agency/sub-contractor for the detailed design, design support, manufacture, quality control, testing, transportation, erection support, and implementation of UHPFRC girder works. The proposed agency shall possess demonstrated technical knowledge and capability in UHPFRC/UHPC technology, including material design, structural design principles, prestressing systems, production methodology, curing requirements, durability provisions, quality assurance procedures, handling, transportation, and erection of UHPFRC structural elements. Appointment of such agency shall be subject to the approval of the Employer/Engineer-in-Charge.

The specialized agency shall have qualified structural engineers and technical personnel familiar with the design philosophy, codal requirements, international best practices, manufacturing processes, and construction methodologies applicable to UHPFRC structures. Preference shall be given to agencies that have successfully participated in the design, manufacture, supply, erection, or execution of UHPFRC/UHPC girders, precast bridge elements, advanced concrete bridge systems, or similar specialized structural components in Government, Semi-Government, Metro Rail, Railway, National Highway, State Highway, Urban Infrastructure, or other public infrastructure projects. The Contractor shall submit documentary evidence such as work orders, completion certificates, client certificates, technical approvals, project reports, or other acceptable proof demonstrating the credentials and experience of the proposed agency.

The detailed design of UHPFRC girders and associated structural components shall be carried out in accordance with relevant IRC, IS, international standards, project specifications, and accepted engineering practices applicable to UHPFRC structures. The complete design, methodology, material specifications, quality assurance plan, testing programme, and construction methodology shall be independently reviewed and vetted by a reputed technical institution such as IIT, IISc, or any other institution approved by the Employer. The specialized agency shall work in close coordination with the design-vetting institution and shall incorporate all observations, recommendations, and modifications required during the design review process. The Contractor shall also establish a comprehensive quality control and quality assurance system for production and

construction of UHPFRC girders, including material characterization, trial mixes, prototype testing, production testing, durability assessment, and performance validation, as directed by the Employer and the design-vetting institution.

Notwithstanding the engagement of any specialized agency or the acceptance of any design by the Employer or the design-vetting institution, the Contractor shall remain fully responsible for the structural adequacy, durability, quality, safety, performance, and successful completion of all UHPFRC girder works under the Contract.

2.9 Load Testing

a. General Requirements

i. Before commencement of production works and foundation execution, the Contractor shall, at his own cost and risk, carry out initial load tests, routine load tests, lateral load tests and integrity tests on pile foundations for the Elevated Corridor, elevated rotary/interchange structures, portal frame locations, second-level carriageway portions and associated structures in accordance with relevant provisions of IRC:78, IS:2911, IRC:SP:114, IRC:SP:84 and other applicable IRC/BIS Codes and Specifications.

ii. In addition to pile testing, wherever the Employer/Authority Engineer considers any structural system, UHPFRC/UHPC girder configuration, portal frame arrangement, special span, rotary structure, curved segment, erection methodology or structural component to be of special or unusual nature, the Contractor shall carry out prototype testing, proof load testing, model studies, field performance testing, mock-up trials or structural behaviour studies as directed by the Employer.

b. Pile and Foundation Testing

i. Initial load tests shall generally be carried out on designated test piles to establish safe axial load capacity, lateral resistance, settlement characteristics and design assumptions.

ii. Routine load tests, pile integrity tests, cross-hole sonic logging tests or equivalent approved non-destructive tests shall be carried out on working piles as specified in relevant Codes and approved quality assurance plans.

iii. The Contractor shall submit detailed test procedures, instrumentation details, loading arrangements, interpretation methodology and test reports for approval.

c. Superstructure and Structural Load Testing

i. If required by the Employer/Authority Engineer, the Contractor shall carry out load testing on any portion of the superstructure including UHPFRC/UHPC U-Girders, strutted box girders, I-Girders, portal frames, elevated loop structures, second-level carriageway structures or completed spans to verify structural behaviour, deflection, vibration characteristics, stability and performance under design loading conditions.

ii. The load test methodology shall conform to relevant IRC Codes including IRC:SP:51, IRC:SP:37, IRC:112 and other applicable standards/guidelines.

d. Circumstances Requiring Testing

The Employer may instruct additional testing or proof checking in the following situations:

i. Failure of concrete cubes/specimens or non-conformance with specified strength/performance requirements.
ii. Premature removal of formwork, supports or staging.
iii. Improper curing, casting defects or construction deficiencies.
iv. Doubts regarding structural integrity, workmanship, geometry control or material quality.
v. Introduction of modified structural systems, revised erection methodology or altered construction sequence.
vi. Verification of behaviour of UHPFRC/UHPC structural components, joints, diaphragms or special structural arrangements.

e. Cost of Testing

i. All mandatory tests specified under IRC/IS/MoRTH Specifications, approved Quality Assurance Plans and Contract requirements shall be deemed included in the Contract Price.

ii. Tests ordered due to defective workmanship, material deficiencies, construction negligence or failure to meet specifications shall be carried out entirely at the Contractor's cost.

iii. Where special model studies, proof testing or performance testing are ordered solely for validation of innovative systems or special design requirements and the results are satisfactory, the Employer may consider reimbursement only if specifically approved under Contract provisions.

f. Contractor's Responsibilities

The Contractor shall make all arrangements for testing including:

i. Preparation and submission of detailed test calculations, loading schemes, instrumentation plans and observation procedures.
ii. Deployment of calibrated equipment, reaction systems, kentledge, sensors, monitoring instruments and safety arrangements.
iii. Recording of settlements, strains, deflections, rotations, vibrations, crack behaviour and other structural responses during and after testing.
iv. Submission of complete test reports, analysis and interpretation certified by the Designer/Proof Consultant.

g. Defects and Rectification

Any defects, distress, excessive deflection, cracking, settlement or structural inadequacy observed during testing shall be rectified by the Contractor at his own cost through approved remedial measures, strengthening, redesign or replacement as directed by the Employer/Authority Engineer.

h. Completion of Testing

Upon completion of testing, all temporary loading arrangements, kentledge, staging, instrumentation and associated temporary works shall be removed by the Contractor and the structure/site restored to the satisfaction of the Employer.

i. Special Provisions for Prestressed and UHPFRC Structures
ii. Load testing of prestressed/UHPFRC/UHPC superstructure components shall consider temperature variations, creep, shrinkage, prestress losses, construction stage effects and time-dependent behaviour. Necessary corrections and monitoring provisions shall be incorporated while evaluating test results in accordance with relevant IRC recommendations and approved proof checking procedures

2.10 Slip Roads, other Surface Level Roads, Culverts and Junction Improvements

The Work of **Approach Road i.e. Solid Ramp Portion** to be carried out under this Contract. The Total Scope of Road work is 2100 m considering both side.as per followings:

a. Construction of **Approach Road i.e Solid Ramp Portion** including Dismantling of Existing Structures coming on the Carriageway such as Govt. Buildings, Compound, Drains, Footpaths, Kerbs, Medians, Parapet Walls; Construction/widening of Culverts/Box culverts; etc

- Slip Roads beyond the Lengths of the approaches to Elevated Rotary Ramps are to be merged with Existing Roads through a Taper / Transition of 1 in 15.

b. Construction of Medians; Kerbs, Footpath, Storm Water Drains with Drain Cover Slabs where ever missed and necessary, Traffic Signages, Overhead Gantry, Road Marking such as Lane Marking, Pedestrian Marking, Direction Marking, STOP and STOP Lines, etc. as per the Specifications given MoRT&H and Kerb Painting as per the Specifications mentioned in this Tender Document.

c. The Construction of Medians, Kerbs and Footpath shall conform to Clause 407, 408 and 409 of the MoRT&H Specifications for Road and Bridge Works (Latest Edition).

d. Dismantling of Existing Road Over Bridge at IOC Junction with down ramp loop, etc. and reconstruction with Elevated Rotary with approaches as per the structural design mentioned above section 2.8.

2.11 Submission of Elevated Corridor/Rotary design Reports for approval

After award of work, Successful Tenderer shall submit the following design reports for Approval

1. Design basis report of the bridge stating the salient features of bridge, i.e span, skew angle span arrangements, longitudinal eccentrics, depth of girders, type of superstructure UHPFRC/STEEL, R.C.C., PSC, composite, type of bearings arrangement with sketch showing fixed/free ends, curvature if any and the details of parameters codes, load combinations cases, wind, seismic zone etc. For drawings of non-standard span of Railways must duly proof checked by IIT/IISc, NIT/approved consultants for this purpose before submitting the detail design.

2. Soil report of the railway bridge site with bore hole at each railway pier and abutment location and also shown on sketch showing the bore holes locations w.r.t to pier/abutment positions. The recommendations of the soil consultant for the open foundation/pile foundation if applicable clearly stating the pile length with safe loads for two three alternates.

3. The feasibility of the structure or components must be checked in all respects by the tenderer before submitting the design to Railway/ B-SMILE office and signed by the authorized signatories of Tenderer.

4. The drawing must be submitted in preferably A-I size only in prescribed/standard format.

5. The design/drawing of the test pile is to be submitted if applicable for the approval as per the codal provisions duly proof checked by IITs lNIT/approved consultants.
6. The software/staad files hard copy as well as soft copy must be submitted with the design note used in design for help in checking the design.

7. PSC Superstructure has to be as per IRC-112, Composite Superstructure has to as per IRC-24

8. Stress summary should be prepared for each component of the bridge i.e. pile or open foundation as applicable, pile cap/foundation slab and beam, pier, pie cap, stating the actual stresses vs permissible stresses or steel provided vs steel required.

9. A certificate from the proof checking agency on successful Tenderer letter head stating that the design and drawing of the bridge has been checked by me and found in order as per the latest IRC codal provisions.

2.12 Safety precautions and measures to be observed during execution of Elevated Rotary works in Project road and Adjoining areas

The works required to be done under traffic block protection, are to be carried out only in the presence of Traffic Police officials. The Traffic supervisor has to certify safe conditions for passage of main traffic. Following important activities of works shall be carried out under supervision of Traffic nominated Supervisor

a) Excavation at foundation/Ground level near to Road Median.

b) Concrete casting and/or masonry very close to Road Median.

c) Erection of temporary structures near to running lines.

d) Casting of structures like girder/slab over Pier cap/Portal frame.

e) Stage-Pre-stressing of girders when placed across Pier cap properly supported.

f) Launching of precast/pre-assembled girders across Road.

g) Any work of lifting, side shifting and slewing of girders over the Traffic road.

h) Dismantling of temporary structures, shutters, scaffolding etc. adjacent to the Project Road.

i) For carrying out activities of casting, erection, launching, handling and dismantling as listed above, the Contractor's Engineering shall furnish the Construction Programme in advance to Traffic Police. No such work should be taken up in absence of the Supervising Traffic police inspectors. For the activities which are to be done in presence of the Traffic police, prior intimation shall be given in writing and acknowledgement obtained from Traffic representative. Such activities of work shall not be carried without the presence of Traffic police.

2.13 **Traffic Diversion and Traffic Management during Construction**

The Contractor shall design, plan, construct, operate, maintain, modify and remove all Temporary Traffic Diversion Arrangements, Traffic Management Systems and Construction Stage Traffic Circulation Plans required for execution of the "Construction of Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road (Length approximately 5.2 km) in Bengaluru City".

The Contractor shall ensure safe, continuous and uninterrupted movement of public traffic, BMTC buses, emergency vehicles, pedestrian traffic, utility access and access to adjoining commercial, residential and institutional properties throughout the construction period. The Contractor shall prepare detailed Traffic Diversion Plans, Stage-wise Construction Methodology, Barricading Layouts, Temporary Road Layouts, Signage Plans, Lane Closure Proposals, Temporary Junction Improvement Plans and Traffic Safety Arrangements in coordination with Bengaluru Traffic Police, BBMP, BMRCL, Utility Agencies and other concerned Authorities.

The traffic diversion arrangements may include temporary service roads, phased lane closures, one-way traffic circulation systems, utilization of existing parallel roads, temporary widening of carriageways, temporary median openings, signal modifications, night-time construction operations, temporary junction channelization, temporary steel plate crossings, pedestrian management arrangements and other traffic engineering measures as required depending upon site conditions and construction stages.

Indicative diversion corridors and traffic redistribution routes may include:

Sirsi Circle – Chamarajpet – Mysuru Road parallel stretches,
Vijayanagara – Gopalan Mall – Gali Anjaneya Temple Junction corridor,
Service roads and parallel local roads along Mysuru Road,
Nayandahalli Junction connectivity roads,
Other interconnected urban roads and alternative routes as approved by Bengaluru Traffic Police and the Engineer-in-Charge.

The Contractor shall specifically plan and manage traffic diversion arrangements near major junctions including Sirsi Circle, Vijayanagara Junction, Gopalan Mall Junction, Gali Anjaneya Temple Junction and Nayandahalli Junction, considering the proposed split elevated carriageways, loop ramps, portal frame structures, cantilever pier arrangements and integration with existing flyovers and metro infrastructure.

The Traffic Diversion Drawings, if enclosed in the Tender Documents, are only indicative and intended to broadly indicate the scope and traffic management philosophy. The Contractor shall carry out detailed traffic studies, traffic volume assessments, queue length analysis, simulation studies, turning movement studies and intersection management studies and shall prepare final stage-wise traffic diversion proposals suitable to actual site conditions and construction methodology.

Before commencement of any work affecting existing traffic movement, the Contractor shall prepare detailed diversion proposals in consultation with the Employer/Engineer-in-Charge and submit the same for approval by Bengaluru Traffic Police and other concerned Authorities. The Contractor shall also make necessary arrangements for public notification, cautionary information systems and traffic awareness measures wherever required.

The Contractor shall provide, install, operate and maintain all necessary traffic safety devices including barricades, retro-reflective signage, blinkers, delineators, traffic cones, caution boards, diversion boards, speed calming arrangements, temporary lighting, crash barriers, pedestrian protection systems and warning systems in accordance with IRC:SP:55, IRC:67, IRC Work Zone Safety Guidelines, MoRT&H Specifications and directions of the Traffic Police and Engineer-in-Charge.

The diversion and construction staging shall be planned in such a manner that inconvenience to the travelling public is minimized to the maximum extent possible and safe movement of traffic is maintained at all times. The Contractor shall ensure proper work zone safety management and regulated movement of construction vehicles, machinery and materials within the Project corridor.

The Contractor shall maintain all existing roads handed over to him in traffic-worthy condition during the entire

construction period. The scope shall include rectification of wear and tear, potholes, damaged stretches, temporary riding surface improvements, drainage maintenance and periodic resurfacing wherever required as directed by the Engineer-in-Charge for smooth movement of diverted traffic.

The Contractor shall also include the cost of temporary and repetitive resurfacing, junction improvements, temporary pavement strengthening, road safety arrangements, traffic marshals and all incidental works necessary for maintaining traffic during the construction period. No separate payment shall be made for Traffic Diversion and Traffic Management arrangements, and the cost thereof shall be deemed to be included in the Contract Price.

All traffic diversion arrangements, temporary works and construction staging shall conform to relevant IRC Codes, MoRT&H Specifications, Bengaluru Traffic Police requirements and instructions issued by the Employer/Engineer-in-Charge from time to time.

2.14 Traffic Signs, Markings and other Road Appurtenances

Traffic Signs, Markings and other Road Appurtenances shall conform to Clause 800 of the MoRT&H Specifications for Road and Bridges (Latest Edition) and shall be shown in the Drawings submitted with the Technical Bid. Road Markings shall conform to IRC: 35 (Latest Revision) and Road Signs shall conform to IRC: 67 (Latest Revision). The Tenderer shall submit the Detailed Drawings of the Signages required as per the relevant IRC Specifications. Overhead Gantry by indicating Destinations as per the Approval of the Employer shall be provided at the Approved Location. Signages shall be provided with Retro Reflective, Micro Prismatic Reflectionised Stickers. Advanced Direction Boards with similar Specifications as above shall be provided at Locations mandated by IRC and as directed by the Employer.

2.15 Drainage System

The Contractor shall carry out Hydraulic Study in the entire Catchment Area, which is having influence on the Battery Limit of the Project, in order to assess the Quantity of Runoff to be drained off from the Battery Limit. For this purpose, the Contractor shall map the Storm Water Drainage System, which passes through the Battery Limit. He shall calculate total Quantity of Runoff, which precipitates on the Battery Limit Area and enters the Battery Limit Area. The Contractor shall work out a Comprehensive Drainage System for Disposal of Runoff collected in the Elevated Rotary/ROB, on Surface Level Road by Gravity Flow only and the Drain shall be connected to the nearest Natural Storm Water Drain and as per the Approval of the Employer.
All Drainage System shall conform to Clause 309 of MoRT&H Specifications for Road and Bridges (Latest Edition).

However, the Levels and Dimension Details for Drainage Arrangement shown in the Drawings are only indicative. The Contractor shall carry out the required Hydraulic Study and work out the Levels and Dimension Details for Drainage Arrangement based on the Hydraulic Study.

The Tenderer shall indicate a Comprehensive Drainage Arrangement System in the Drawings to be submitted at the time of execution.

The Lump Sum Cost quoted by the Tenderer shall include rectification and restoration to the proper drainage work. During the Construction, the Water, which is met with, shall be pumped into the Roadside Drains. At no point it shall be pumped into BWSSB Sewer / Sanitary Lines.

2.16.1 Carriageway Improvement Works

The Works to be carried out under this EPC Contract shall include carriageway improvements, restoration of damaged roads, reconstruction works, junction integration works, slip roads and associated pavement works within the Project influence area as directed by the Employer/Engineer-in-Charge.

i. Improvements to carriageway stretches within the Project limits shall include dismantling/removal of existing damaged black topped/concrete surfaces, disposal of dismantled materials, scarification, excavation, utility restoration and reconstruction of pavement crust comprising subgrade, GSB, WMM, DLC/PQC, bituminous layers or Thin White Topping, as applicable, conforming to relevant MoRTH Specifications and approved pavement composition.

ii. Restoration and reconstruction of existing roads damaged due to pile foundation works, utility shifting, excavation, traffic diversion arrangements, movement of heavy construction equipment and all other construction activities shall be carried out continuously along all pier locations throughout the Elevated Corridor alignment where elevated

corridor construction is not proposed but affected due to project-related activities.

iii. The restored roadway shall conform to the same or higher specification, pavement composition, pavement crust thickness and riding quality as the original/existing roadway condition prior to commencement of the Works, as directed by the Engineer-in-Charge.

iv. The scope shall also include new construction of Thin White Topping road works for cumulative length of approximately 1200 m as specified under Clause 1.3(y), including associated drainage arrangements, kerbs, utility integration, footpaths, paver blocks, service/buffer zones, storm water drain arrangements and allied civil works complete in all respects.

v. Providing and applying tack coat/prime coat on prepared bituminous surfaces shall conform to relevant MoRTH Specifications and approved construction methodology.

vi. Providing and fixing precast concrete kerb stones, medians, edge restraints and associated finishing items shall conform to approved drawings and relevant IRC/MoRTH Specifications.

vii. . Road Markings, Road Studs and At-Grade Carriageway Improvements

Road markings using Hot Applied Thermoplastic Compound with reflectorised glass beads shall be provided throughout the entire Project Corridor, including elevated carriageways, slip roads, approach roads, at-grade roads, junction improvement areas, rotary/interchange portions, traffic diversion stretches and all reconstructed carriageway portions within the Project limits, as directed by the Employer/Engineer-in-Charge.

a. Providing and laying Hot Applied Thermoplastic Compound of 2.5 mm thickness, excluding surface-applied glass beads, with reflectorising glass beads at 250 g/sq.m shall conform to IRC:35 (Latest Edition), MoRTH Specifications and approved traffic safety standards. The finished markings shall be uniform, smooth, skid-resistant and free from streaks, waviness and defects.

b. The road markings shall include edge lines near footpaths and medians, lane markings, centre broken lines, stop lines, directional arrows, chevron markings, zebra crossings, channelizers, junction markings, rotary markings, speed regulation markings, hazard markings and all other traffic safety markings required for proper traffic management and integration throughout the Project Corridor.

c. Providing and fixing reflective road studs/raised pavement markers of size 100 mm × 100 mm, die-cast in aluminium or approved equivalent corrosion-resistant material fitted with reflective lenses, shall be carried out along medians, edge lines, lane separators, curves, ramps, junctions and traffic channelization areas in accordance with relevant IRC/MoRTH Specifications and approved traffic safety plans.

d. The Contractor shall carry out carriageway maintenance, rectification and improvement works at grade throughout the Project influence area and within the battery limits, including damaged stretches affected due to construction activities, traffic diversions, utility works and movement of heavy machinery.

e. The scope shall also include asphalt/bituminous pavement restoration and strengthening works, wherever required, including DBM/BC layers, milling, overlaying and patch rectification works conforming to approved pavement composition and MoRTH Specifications. Minimum quantities indicated in the Contract shall be treated as indicative and the Contractor shall execute the required extent of works necessary for proper restoration, riding quality and traffic integration within the Project limits as directed by the Engineer-in-Charge.

2.16.2 Paved Pedestrian Crossing / Footpath and Utility Crossing Works

The Works of providing paved pedestrian crossings, footpath crossings, utility access crossings and associated pedestrian movement facilities under this EPC Contract shall include the following:

i. Scarifying/removal of existing bituminous surface, concrete surface, surface dressing or premix carpet, including collection, stacking and disposal of dismantled/unserviceable materials complete in accordance with MoRTH Specifications and directions of the Engineer-in-Charge.

ii. Providing and applying tack coat/prime coat on prepared bituminous surfaces conforming to relevant MoRTH Specifications and approved construction methodology.

iii. Providing and laying bituminous concrete/approved wearing surface of required thickness using approved hot mix plant, crushed aggregates, bituminous binder and paving equipment, laid to proper line, grade, camber and level and compacted with suitable rollers to achieve specified density and riding quality in accordance with MoRTH Specifications.

iv. Providing and laying heavy-duty interlocking concrete paver blocks/cobble stones of approved thickness, size, colour and pattern over prepared granular/sand bedding, including edge restraints, joint filling, compaction and finishing complete for pedestrian crossings, footpaths, utility access zones, median openings and traffic channelization areas as directed by the Engineer-in-Charge.

v. Providing and fixing precast RCC slabs/cover slabs for side drains, utility trenches, chambers, crossings, duct covers and pedestrian access locations including reinforcement, formwork, lifting arrangements, finishing, curing and all incidental works complete in accordance with approved drawings and specifications.

vi. The scope shall also include tactile paving, kerb ramps, pedestrian safety features, accessibility provisions, utility coordination, drainage integration and restoration of adjoining surfaces required for safe pedestrian movement within the Project limits.

2.16.3 Pipe Duct / Drainage and Utility Crossing Works

The Works to be carried out under this EPC Contract shall include construction of pipe ducts, utility crossings, storm water drainage arrangements, shoulder drains and associated drainage improvement works within the Project Corridor and influence areas.

i. The scope shall include excavation, laying and construction of RCC pipe ducts/utility crossings across roads at identified locations all along the elevated corridor and other locations as directed by the Engineer-in-Charge, for an approximate cumulative length of 65 m or as required based on site conditions and utility integration requirements.

ii. The works shall include excavation, shoring/dewatering wherever required, providing and laying Plain Cement Concrete bedding of minimum 100 mm thickness, laying of NP3 class RCC Hume pipes of required diameter (generally 300 mm diameter or as approved in design), jointing, encasing/protection works, backfilling and restoration complete in accordance with MoRTH Specifications and approved drawings.

iii. Pipe ducts/drainage lines shall be laid to the required gradient/slope to ensure proper hydraulic flow and integration with existing and proposed storm water drainage systems.

iv. Packing/backfilling around and above the pipes shall be carried out using selected earth/granular material and compacted in layers to achieve the required density and stability as per approved specifications and directions of the Engineer-in-Charge.

v. The Contractor shall also provide shoulder drains, cross drains, catch pits, drainage chambers, utility trenches and associated drainage arrangements at waterlogging and low-lying locations along the Project Corridor to ensure proper surface runoff and prevention of flooding/water stagnation.

vi. The Contractor shall carry out necessary hydraulic studies, drainage investigations, level surveys and utility coordination for finalizing the drainage arrangement, pipe sizes, invert levels, slopes and outfall connectivity. Detailed drawings/designs shall be submitted and approved by the Employer/Engineer-in-Charge prior to execution.

2.16.4 Road Side Existing Drain

The main objective of this Work is to ensure free and uninterrupted flow of storm water collected from the Right of

Way (ROW), elevated corridor structures, carriageways, adjoining properties, junction areas and utility corridors throughout the Project influence area.

The Works to be carried out under this EPC Contract shall include inspection, restoration, improvement, desilting, modification and reconstruction of existing roadside drains/storm water drains within the Project limits and influence areas, irrespective of the quantities indicated elsewhere in the Contract documents including Clause 2.17.10.

The scope of work shall generally include the following:

i. Removal, resetting, replacement and reconstruction of existing drain slabs, cover slabs, side walls, drain edges and damaged drainage components wherever affected due to construction activities or required for proper drainage integration.

ii. Desilting, cleaning and removal of debris, silt, vegetation, obstructions and deposited materials from existing roadside drains/storm water drains for smooth hydraulic flow and prevention of water stagnation/flooding.

iii. Repair, strengthening, widening, deepening, extension or reconstruction of existing drainage arrangements wherever required for proper discharge of storm water from elevated structures, carriageways, slip roads, service roads and adjoining areas.

iv. Integration of existing drains with newly proposed drainage systems, pipe ducts, catch pits, utility crossings and storm water outfalls within the Project Corridor.

v. Restoration of all disturbed drainage portions and surrounding areas complete in all respects as directed by the Engineer-in-Charge.

2.16.4.1 Improvement / Reconstruction of Existing RCC Covered Drain with Precast Slabs

This Work involves maintenance, restoration, strengthening, modification and reconstruction of existing RCC roadside drains retained along the Project Corridor, including construction of new RCC covered drains at missing or deficient locations wherever required for proper storm water management and hydraulic continuity.

The scope generally includes improvement/reconstruction of RCC covered drains of approximate dimensions 1.0 m width × 1.0 m depth or as finalized through approved hydraulic design and site requirements, including precast RCC cover slabs and associated drainage components.

The above Work shall include the following items:

i. Earthwork excavation for new drain portions, widening/deepening of existing drains, dressing of sides and preparation of foundation bed complete as required.

ii. Removal and disposal of disused/damaged materials, debris, silt and obstructed drainage components from existing drains.

iii. Providing and laying PCC bedding/foundation concrete of required grade and thickness conforming to MoRTH Specifications and approved drawings.

iv. Construction, strengthening or reconstruction of RCC drain side walls, base slabs, drain covers, junction chambers and associated RCC components using approved design mix concrete, reinforcement, formwork, dewatering and finishing complete in all respects.

v. Repair/restoration of existing RCC drains and resetting/replacement of damaged drain slabs retained along the Project road wherever affected due to construction activities or where required for proper drainage functioning.

vi. Backfilling and compaction around drain structures with approved earth/granular material in layers to required density.

vii. Providing and fixing precast RCC perforated/solid cover slabs of approved thickness with lifting arrangements, reinforcement and finished surfaces complete in accordance with approved drawings and specifications.

viii. Integration of existing and newly proposed drains with storm water collection systems, rainwater harvesting arrangements, pipe crossings, catch pits and utility drainage systems throughout the Project Corridor including rotary/interchange and second-level structure locations.

Further, the Contractor shall carry out necessary hydraulic studies, drainage investigations and level surveys to finalize the dimensions, invert levels, discharge capacity and connectivity of the drainage system and obtain approval of detailed drainage drawings from the Employer/Engineer-in-Charge prior to execution.

2.17.4 Kerb Works

The Works of providing, fixing, restoring and painting kerb stones at required, damaged, missing and newly developed locations under this EPC Contract shall include the following:

i. Providing and fixing precast solid concrete kerb stones of approved size (generally 600 mm × 300 mm × 150 mm or as approved in drawings), manufactured using design mix concrete of approved grade, including necessary foundation concrete, alignment, jointing, cutting, finishing and all incidental works complete in accordance with MoRTH Specifications and approved drawings.

ii. Kerb stones shall be provided along medians, footpaths, slip roads, junctions, rotary/interchange areas, approach roads, utility zones, traffic islands, divider edges and all other required locations throughout the Project Corridor, including replacement/restoration of damaged kerbs affected during construction activities.

iii. The cumulative minimum kerb length under the Project shall generally be about 8000 m or as required for complete execution of the corridor works and traffic integration requirements.

iv. Painting of kerb stones/medians shall include surface preparation and application of two or more coats of approved synthetic enamel/reflective paint in approved colour combinations conforming to IRC/MoRTH standards for traffic safety and visibility throughout the Project Corridor.

v. The Contractor shall maintain uniform alignment, aesthetics, drainage compatibility and riding safety while executing all kerb and edge restraint works within the Project limits.

2.17.5 Footpath and Pedestrian Facilities

The Works of providing, reconstructing, restoring and improving footpaths/pedestrian facilities, including damaged locations, under this EPC Contract shall include construction of footpaths, pedestrian access zones, utility corridors, buffer areas and associated urban streetscape works for an approximate cumulative area of 5000 sq.m or as required for complete integration within the Project Corridor.

The scope of work shall generally include the following:

i. Earthwork excavation, dressing, preparation and levelling of formation/subgrade for footpath and pedestrian utility zones.

ii. Removal and disposal of disused/damaged materials, debris and unsuitable earth from the work area.

iii. Surface preparation, compaction and provision of suitable granular/sub-base layers as required for stable pedestrian pavement construction.

iv. Construction of RCC edge beams, side walls, retaining edges, utility trenches, drain edges and associated concrete works using approved grade concrete including reinforcement, shuttering, curing, dewatering and finishing complete in all respects as per approved drawings and specifications.

v. Providing and laying sand bedding/base layer of approved thickness for placement of interlocking paver blocks/cobble stones.

vi. Providing and laying heavy-duty interlocking concrete paver blocks/cobble stones of approved thickness (generally 60 mm or as approved), size, colour and pattern with required compressive strength over prepared bedding layer, including compaction with plate vibrator, joint filling, alignment and finishing complete in accordance with MoRTH Specifications and directions of the Engineer-in-Charge.

vii. Footpath works shall include integration with kerbs, storm water drains, utility chambers, street lighting poles, pedestrian crossings, tactile paving, ramps/accessibility provisions, landscaping interfaces and all incidental works required for safe and continuous pedestrian movement throughout the Project Corridor.

viii. The Contractor shall restore all footpaths, pedestrian pathways and utility access areas damaged during execution of elevated corridor works to equal or improved condition conforming to approved urban road standards and traffic safety requirements.

2.17.6 Illumination and Electrical Works

The Illumination and Electrical Works to be carried out under this EPC Contract shall include design, supply, installation, testing, commissioning, replacement, restoration and maintenance of complete street lighting and illumination systems for the Elevated Corridor, elevated rotary/interchange, second-level carriageway, slip roads, at-grade roads, junctions, footpaths and associated Project areas.

The scope of work shall generally include the following:

❖ Providing, fixing, shifting, replacement and restoration of street lighting poles, high mast poles, brackets, fixtures, luminaires, LED lighting systems and associated electrical components within the Project limits.

i. Providing and laying LT/HT underground cables, HDPE/GI cable ducts, junction boxes, feeder pillars, control panels, earthing systems, electrical chambers and associated electrical infrastructure complete in accordance with relevant IS Codes and approved drawings.

ii. Replacement/restoration of damaged box ducts, cable trenches, electrical utilities, poles, fixtures and associated systems affected during construction activities.

iii. Providing illumination arrangements for elevated carriageways, under-deck areas, rotary/interchange zones, pedestrian areas, utility/service roads and traffic integration zones to achieve safe traffic movement and adequate lighting levels as per relevant IRC/IS standards.

iv. Providing earthing, lightning protection systems, electrical safety arrangements, energy-efficient lighting controls and associated accessories complete in all respects.

v. Painting, finishing and corrosion protection treatment for poles, brackets and exposed electrical components using approved paint systems and protective coatings.

vi. Testing, commissioning, energization and coordination with concerned utility/electrical authorities including obtaining statutory approvals wherever required.

vii. Restoration and integration of existing electrical/illumination systems disturbed during execution of the

Project and maintenance of the same during the Contract period as directed by the Engineer-in-Charge

2.17.7 Traffic Signage, Road Safety and Pavement Marking Works

The Traffic Signage, Road Safety and Pavement Marking Works to be carried out under this EPC Contract shall include design, supply, installation, fixing, restoration, testing and maintenance of all traffic safety devices, road signs, guidance systems and pavement marking arrangements throughout the Elevated Corridor Project limits in accordance with IRC, MoRTH and relevant BIS standards.

The scope of work shall generally include the following:

i. Providing and fixing retro-reflective cautionary, mandatory, informatory, directional, overhead gantry, lane guidance, speed regulation, diversion, route identification, junction control and hazard warning signages conforming to IRC:67 (Latest Edition) and relevant MoRTH Specifications.

ii. Sign boards shall generally consist of high-intensity/micro-prismatic retro-reflective sheeting mounted over aluminium composite panels/aluminium sheets of approved thickness and supported on GI/MS posts, gantries, cantilever structures or brackets as approved in design.

iii. Sign supports/posts shall be firmly fixed in properly designed reinforced cement concrete foundations of approved grade and dimensions suitable for wind loading, traffic conditions and structural stability requirements.

iv. The scope shall also include temporary traffic diversion signs, barricading signs, construction zone safety signs, blinkers, delineators, hazard markers, crash cushions, traffic cones and all temporary traffic management systems required during execution of the Project.

v. Providing and laying thermoplastic road markings, lane markings, directional arrows, zebra crossings, edge lines, stop lines, chevron markings, median markings and other pavement markings conforming to IRC:35 and MoRTH Specifications throughout elevated and at-grade portions of the corridor.

vi. Providing and fixing road studs/cat eyes, delineators, reflective markers, median reflectors and associated traffic safety furniture at required locations for safe traffic guidance during day and night conditions.

vii. The Contractor shall ensure integration of traffic signage and road safety arrangements with existing and proposed traffic systems, junction improvements, rotary/interchange portions and pedestrian facilities throughout the Project Corridor.

viii. All signage, pavement markings and road safety systems damaged during construction activities shall be restored/replaced by the Contractor at his own cost and maintained in proper condition during the Contract and maintenance period.

2.17.8 Project Information and Display Boards

The Works under this EPC Contract shall include design, fabrication, supply, installation and maintenance of Project Information Display Boards at prominent and approved locations throughout the Project Corridor as directed by the Employer/Engineer-in-Charge.

i. The display boards shall generally contain details such as name of the Project, name of Employer/Authority, name of Contractor, Contract value, commencement date, completion period, defect liability/maintenance period, traffic advisory information and other particulars as instructed by the Employer.

ii. The boards shall generally be of rectangular shape of approximate size 1.20 m × 0.90 m or such other dimensions as approved by the Employer and shall be fabricated using durable weather-resistant materials with proper supporting arrangements, painting, reflective lettering and foundation works complete in all respects.

iii. The Contractor shall maintain the display boards in proper readable condition throughout the execution period of the Project and replace damaged/faded boards whenever required.

The cost of all such display boards including fabrication, erection, maintenance, shifting and removal shall be deemed to be included in the quoted Contract Price and no separate payment shall be made on this account.

2.17.9 Project Cost Estimate and Scope Consideration

The Project Cost Estimate has been prepared based on the approved conceptual alignment plan, preliminary engineering details, proposed structural configuration, utility requirements, traffic integration provisions and the complete scope of works contemplated for execution of the Elevated Corridor Project from Sirsi Circle to Nayandahalli on Mysuru Road (Length 5.2kms) in Bengaluru city.

The estimate has taken into consideration the quantities and cost implications of all major and incidental components of work including, but not limited to, detailed investigations, utility mapping and shifting, traffic diversion arrangements, geotechnical investigations, design and proof checking, foundations, substructures, superstructures, elevated rotary/interchange structures, second-level carriageway portions, portal frame structures, UHPFRC/UHPC girder systems, casting yard establishment, transportation and launching arrangements, at-grade road works, slip roads, drainage works, footpaths, lighting, traffic safety works, electrical works, road restoration, utility reinstatement, testing, commissioning, maintenance obligations and all associated civil, structural and allied works required for complete execution of the Project.

The Tenderer shall thoroughly study the conceptual drawings, alignment details, traffic conditions, utility constraints, structural requirements, site conditions and complete scope of works before submission of the Bid. Submission of the Bid shall be deemed to indicate that the Tenderer has fully understood the nature and extent of the Project and has included all costs, risks, obligations, temporary works, construction methodologies and associated requirements necessary for successful completion of the Project within the quoted Contract Price.

The successful Contractor shall be responsible for carrying out detailed design, preparation of working drawings, proof checking through approved institutions such as IIT/IISc, obtaining all necessary approvals including GAD approvals from concerned authorities/Railways wherever applicable, establishment of casting yard, execution of all permanent and temporary works, testing, commissioning and maintenance obligations required for complete execution of the Project.

The elevated corridor superstructure generally comprises UHPFRC/UHPC strutted box girders for wider carriageways, UHPFRC U-Girders for standard carriageways, UHPFRC I-Girders for portal frame and special span arrangements, elevated rotary/interchange structures, second-level carriageway portions and associated structural systems as indicated in the conceptual drawings and tender documents.

No variation in structural quantities, structural configuration, span arrangement, dimensions or scope within the approved conceptual plan area shall ordinarily be considered, and the Contractor shall complete the entire scope of work within the quoted Contract Price. However, any additional structural length or extension beyond the approved conceptual plan area specifically instructed by the Employer due to Government-approved requirements shall be dealt with in accordance with the relevant Special Conditions of Contract governing variation provisions.

3.0 Documentation, Instrumentation, etc.

a. All Drawings shall be made in Latest Version of AutoCAD and the Soft Copies on CDs and ten Hard Copies of Prints of all Approved Drawings and "As Built" Drawings shall be supplied by the Contractor to the Employer at Free of Cost as per the Agreed Programme.
b. CDs and ten Hard Copies of all Approved Design Calculations shall be submitted by the Contractor to the Employer at Free of Cost as per Agreed Programme.
c. Five Video CDs of 180 minutes duration each of the Elements covering the Different Phases of Construction from Start to Finish shall be supplied by the Contractor to the Employer at Free of Cost.
d. Three Copies of "Maintenance Manual" describing Access Arrangements, Important Obligatory Precautions

from the Point of View of Structural Safety and Procedure for Minor and Major Repairs of each Component of the Elements, Renewals of Finishes and Treatments periodically including Guarantee / Warranty Certificates shall be supplied by the Contractor to the Employer at Free of Cost.

e. Three Copies of "Quality Assurance Manual" covering Designs and Drawings, Mix Designs, Materials, Testing, Soil and Rock Properties, Statistical Quality Control, etc. shall be prepared by the Contractor and submitted to the Employer at Free of Cost well before Starting the Work.
f. Three Copies of “Safety Manual” covering necessary Safety and Precautions to be adopted by the Contractor as per Requirements and as per Standards during execution of the Work.
g. Three Copies of "Construction Manual" covering Various Aspects of Construction Methods, Difficulties faced and how they are overcome during Execution, etc. shall be supplied by the Contractor to the Employer at Free of Cost at the Time of Finalisation of Work.
h. The Contractor shall install Fixtures and Fastenings provided by the Employer for housing any Instrumentation that may be useful for the Employer at Contractor’s Cost.
i. Fixing Arrangement for Internal and External Lighting shall be approved by the Employer and executed by the Contractor.

4.0 Programme for Submission and Approval of Designs and Drawings

The Programme for submission of Designs and Drawings for the Elevated Corridor Project from Old Madras Road (Swami Vivekananda Metro Station) to Silk Board Junction via Indiranagar, Domlur and Madiwala is listed below considering that the total Design and Construction Period presently stipulated by B-SMILE/Government Authorities is restricted to Eighteen (18) Months including monsoon period. Accordingly, the Contractor shall plan and execute all design, proof checking, approvals, casting yard establishment and construction activities through parallel and fast-track execution methodology.

Sl No	Details	Time from Date of Award
1	Award of Work	0
2	Submission of Topographic Survey, Utility Mapping, Preliminary Geotechnical Investigation and Inception Report	3 Weeks
3	Submission of Horizontal & Vertical Geometry, Preliminary GADs, Traffic Diversion and Traffic Management Schemes	5 Weeks
4	Submission of Preliminary Structural Design Parameters, Construction Methodology, Casting Yard Layout, Quality Assurance Manual and Safety Manual	6 Weeks
5	Submission of Design and Construction Drawings for Foundations including Pile Foundations and Pile Caps	8 Weeks
6	Submission of Design and Drawings for Piers, Pier Caps, Portal Frames and Substructures	10 Weeks
7	Submission of Design and Drawings for UHPFRC/UHPC Superstructures including U-Girders, Strutted Box Girders, I-Girders, Elevated Rotary and Second-Level Structures	14 Weeks
8	Submission of Design and Drawings for Bearings, Expansion Joints, Deck Works, Drainage, Electrical Works, Utility Integration and Balance Components	16 Weeks
9	Submission of Final Coordinated Good-for-Construction Drawings	18 Weeks
10	Submission of As-Built Drawings, Completion Documents and Maintenance Manuals	Within 4 Weeks after Completion of Work

Accordingly, the Contractor shall deploy adequate design consultants, proof checking coordination teams, multiple construction fronts, machinery, manpower, precasting facilities and parallel execution methodology to achieve completion within the stipulated period.

The Contractor shall also take into account monsoon impacts, dense urban traffic conditions, utility shifting constraints, restricted working space, traffic diversion requirements, railway coordination, elevated rotary/interchange complexity, second-level structural integration and specialized UHPFRC/UHPC construction methodology while planning the execution schedule.

It is clarified that the above stipulated period has been administratively fixed by the Employer/Government Authorities. However, if extension of time becomes necessary due to reasons attributable to the Employer, Government approvals, utility shifting delays, traffic restrictions imposed by statutory authorities, railway permissions, force majeure conditions or other reasons beyond the control of the Contractor, the same shall be considered in accordance with relevant Conditions of Contract.

The Design shall be submitted in sufficient detail and clarity to enable expeditious proof checking by IIT/IISc or approved Proof Consultants/Third Party Engineers appointed by the Employer. Approval of drawings and designs by the Employer or Proof Consultant shall not relieve the Contractor from responsibility towards structural adequacy, safety, durability and correctness of design.

All redesigns arising due to utility conflicts, site requirements, authority observations or construction methodology modifications shall be carried out by the Contractor without affecting the progress of the Works.

The Contractor's Designer/Consultant shall attend all design review meetings and coordination meetings conducted by the Employer or reviewing agencies without any additional cost.

The Contractor shall submit complete As-Built Drawings, final design records, maintenance manuals and digital documentation within four (4) weeks from completion of the Works. Suitable penalties and withholding provisions may be applied for delay in submission of such completion documents.

4.1 Resource Planning and Deployment of Major Construction Equipment

The Contractor shall plan, mobilize, deploy, operate, and maintain adequate construction plant, machinery, equipment, manpower, casting facilities, erection systems, testing facilities, traffic management arrangements, and all other resources necessary for successful execution and completion of the project within the stipulated contract period of eighteen (18) months.

The project completion period of 18 months has been assessed considering simultaneous execution of piling works, foundations, substructure works, precast/UHPFRC superstructure works, segment casting, transportation, erection and launching activities, utility shifting, traffic management measures, and associated civil works at multiple work fronts. Accordingly, deployment of adequate resources at different locations concurrently shall be the responsibility of the Contractor to achieve the prescribed milestones and completion targets.

For planning of the construction schedule and assessment of the feasibility of completion within 18 months, the Employer has considered deployment of the minimum key and critical equipment listed below. The Contractor shall ensure availability of not less than the minimum quantities indicated against each item throughout the execution period. Where required to maintain progress or execute works simultaneously at multiple locations, the Contractor shall augment the plant and machinery over and above the minimum specified quantities at no additional cost to the Employer.

The Contractor shall demonstrate availability by owning at least fifty percent (50%) of the key and critical equipment listed below. The remaining fifty percent (50%) may be arranged through lease, hire, or other legally enforceable arrangements, provided valid documentary evidence such as ownership documents, lease agreements, hire agreements, commitment agreements, or similar proof of assured availability for this project is furnished to the Employer.

The minimum equipment requirement indicated below has been considered while fixing the target completion period of 18 months and shall form the basis for resource planning by the Contractor. The Contractor shall also deploy all additional machinery, minor equipment, tools and plants, field laboratories, testing equipment, survey instruments, temporary works systems, safety arrangements, traffic management systems, and other resources as may be required for timely completion of the project.

Applicants/Bidders shall indicate the make, model, year of manufacture, capacity, ownership status, and working condition of the proposed equipment. Failure to deploy and maintain adequate resources shall not constitute grounds for extension of time, additional payment, or any claim against the Employer.

Schedule of Minimum Key and Critical Equipment Considered for Completion of the Project within 18 Months

Sl. No.	Description of Equipment	Minimum Requirement	Own	Hire
2	Hydraulic Rotary Piling Rig suitable for minimum 12 00 mm dia and 40 m depth piles	2 Nos	-	2
3	Crawler Crane / Hydraulic Crane of 75T to 100T Capacity	4 Nos	1	3
4	Heavy Duty Launching Girder / Segment Erection Gantry suitable for Segmental U-Girder / Box Girder erection	1 No	-	1
5	Straddle Carrier / Segment Transporter / Trailer for precast segment handling	4 Nos	-	4
6	Portal Frame Erection Equipment / Temporary Support System for long span erection	2 Sets	-	2
7	Hydraulic Strand Jack / Stressing Equipment for PSC/UHPFRC/UHPC works	4 Sets	2	2
8	Automatic Rebar Cutting and Bending Machine	4 Nos	2	2
9	Excavators / Hitachi (Minimum 1 Cum Bucket Capacity)	8 Nos	4	4
10	Tippers / Dumpers (10–20 Ton Capacity)	20 Nos	10	10
11	Backhoe Loaders	6 Nos	3	3
12	Wheel Loaders	3 Nos	1	2
13	Dozers	2 Nos	1	1
14	Vibro Hammer / Casing Oscillator / Bore Stabilization Equipment for piling works	2 Sets	-	2
15	Dewatering Pumps and Slurry Treatment Equipment	4 Sets	2	2
16	Mobile Concrete Boom Placer	2 Nos	-	2
17	Trailer Mounted DG Sets (250–500 KVA)	4 Nos	2	2
18	Survey Equipment including Total Station, Auto Level, GPS/DGPS Instruments	4 Sets	4	-
19	Road Cutting Machine, Milling Machine and Asphalt Paver for approach and utility restoration works	2 Sets	-	2
20	Safety Barricading, Traffic Management Systems, Crash Cushions and Lighting Arrangements for urban construction zones	1 Lot	1	-
21	Self-Propelled Modular Transporter (SPMT) / Equivalent Heavy Lifting System for special span handling (if applicable)	1 Set	-	1
22	Segment Casting Yard Equipment including Moulds, Steam Curing/Controlled Curing Arrangement and Gantry System	1 Complete Setup	1	-

Notes:

Awarded Bidders shall indicate the make, year of manufacture, capacity, ownership status, and working condition of the above equipment.

The Contractor shall additionally deploy:

Minor plants, equipment, tools, tackles, and accessories. Field laboratory, testing equipment, and survey instruments.

Any other equipment, machinery, vehicles, systems, or resources required to achieve the project milestones and complete the work within the stipulated period of 18 months.

The quantities indicated above represent the minimum equipment deployment considered while fixing the project completion period. The Contractor shall augment resources as necessary to execute works simultaneously at multiple locations and maintain the approved construction programme.

5.0 Construction Schedule

The Construction Schedule and the Methodology of Construction shall be so planned that there is Minimum Obstruction to Traffic during Construction and the entire Work can be completed in minimum possible time.

6.0 Site Office

The Contractor shall provide and maintain Furnished Site Office at the Project Location for the Supervisory Staff of the Employer and his approved Representative. It shall have minimum 40 Sqm of Floor Area and shall include all Items like Electric Supply, Electrical Items, Telephones, Lights, Fans and Complete Wiring, Drinking Water Supply and Hygienic Toilet Facilities completed along with Furniture as listed below.

i. Executive Table (for the Employer) : 1 No.
ii. Executive Chair (for the Employer) : 1 No.
iii. Table (for Employer's approved Site Representative, Accountant, Head Clerk and Visitors) : 6 Nos.
iv. Ordinary Chair Type I (for the Employer, Accountant, Head Clerk and Visitors) : 3 Nos.
v. Table (for all other Staff) : 2 Nos.
vi. Ordinary Chair Type II (for all other Staff and Visitors) : 6 Nos.
vii. Steel Almirah 1980mm X 915mm X 485mm : 1 No.
viii. Steel Almirah 1270mm X 765mm X 440mm : 1 No.
ix. Racks – 5 Tier 1800mm X 900mm X 375mm made of Slotted Angles and M.S. Sheets : 3 Nos.
x. Ceiling Fans – 1400mm size. Ceiling Fans shall be of Approved Make and Colour : 3 Nos.
xi. Computer with Printer, Scanner
Core 15 – 650 Processor (4M CACHE, 3.20 GHZ) with 4GB DDR3 RAM,
Hard Disc Capacity 500 GB, 22X DVD Writer, 17" size TFT Colour Monitor,
HP / Laser Printer of 80 Columns, 104 Keyboard, Optical Mouse with Mouse Pad and HP Scanner along with Broad Band Connection : 2 Nos.
xii. Photo Copier : 1 No.

7.0 Field Laboratory

The Contractor shall establish, operate and maintain adequately equipped Field Laboratories for quality control, testing and monitoring of all materials and works related to the Elevated Corridor Project, including UHPFRC/UHPC works, pile foundations, substructure works, superstructure works, road works and allied civil works.

The laboratory facilities shall be either NABL Accredited or associated with an NABL Accredited Testing Laboratory/Firm for conducting mandatory quality control tests as per relevant IRC, IS, MoRT&H and approved technical specifications. The Contractor shall submit documentary proof of such accreditation/association before commencement of works.

The Contractor shall provide a suitably sized and fully functional site laboratory of adequate area with separate

arrangements for concrete testing, aggregate testing, soil testing, steel testing, UHPFRC/UHPC quality evaluation, curing arrangements, storage, calibration and record maintenance. The laboratory shall be established at the casting yard/site office or at suitable approved locations as directed by the Employer/Engineer-in-Charge.

The laboratory shall be provided with all necessary infrastructure and amenities including water supply, uninterrupted power supply, air-conditioned testing rooms wherever required, lighting, internet connectivity, storage racks, curing tanks, work tables, safety arrangements and qualified laboratory personnel.

The Contractor shall provide all required testing equipment, instruments, gauges, moulds, calibration equipment and accessories necessary for routine and specialized testing of materials and works in accordance with relevant IRC/IS/MoRT&H specifications and approved Quality Assurance Plan. This shall include testing facilities for cement, aggregates, concrete, UHPFRC/UHPC materials, admixtures, reinforcement steel, prestressing materials, soil, bituminous materials, pavement layers and other construction materials used in the Project.

All testing equipment shall be periodically calibrated through approved agencies and proper calibration records shall be maintained throughout the Contract Period.

The Contractor shall maintain complete quality control records, cube test registers, material test reports, calibration certificates, pour cards, inspection reports and other documentation in formats approved by the Employer/Engineer-in-Charge.

The Employer/Third Party Engineer/Proof Consultant shall have unrestricted access to the Field Laboratory, testing records and testing procedures at all times during execution of the Project.

7.1 General

i. Oven – Electricity Operated, Thermostatically Controlled, Range upto 200^0C, Sensitivity 1^0C	1 No.
ii. Plat form balance 300 kg capacity	1 No.
iii. Balance 20 kg Capacity – Self Indicating Type	1 No.
iv. Electronic Balance 5kg Capacity – accuracy 0.5 gm	1 No.
v. Water Bath – Electrically Operated and Thermostatically Controlled with Adjustable Shelves, Sensitivity 10^0C	1 No.
vi. Thermometers a. Mercury – in – Glass Thermometer ranges 0 to 250^0C b. Mercury – in – Steel Thermometer with 30 cm Stem, ranges up to 300^0C	4 Nos. each
vii. Glass Wares, Spatulas, Wire Gauzes, Steel Scales, Measuring Tape, Casseroles, Pans, Enameled Trays of Assorted Sizes, Pestle Mortar Porcelain Dishes, Gunny Bags, Plastic Bags, Chemicals, Digging Tools like Pickaxes, Shovels, etc.	As Required
viii. Set of IS Sieves with Lid and Pans 450mm Diameter with Sizes of 63 mm, 53mm, 37.5mm 26.5mm, 13.2mm, 9.5mm 6.7mm and 4.75mm	1 Set
200 mm Diameter of Sizes 2.36 mm, 2mm, 1.18 mm, 600 micron, 425 micron, 300 micron, 150 micron and 75 micron	1 Set
ix. Water Testing Kit for pH, SO_3 and Cl	1 Set
x. First Aid Box	1 Set

7.2 For Soils and Aggregates

i. Rifle Box	1 No.
ii. Atterberg's Limits (Liquid and Plastic Limits) Determination Apparatus	1 Set
iii. Compaction Test Equipment both 2.5 kg and 4.5 kg Rammers (Light and Heavy Compact Efforts)	1 Set
iv. Dry Bulk Density Test Apparatus (Sand Pouring Cylinder, Tray, Can, etc.) complete	1 Set
v. Speedy Moisture Meter complete with Chemicals	1 Set
vi. Posthole Auger with Extensions	1 Set
vii. Core Cutter Apparatus complete with Dolly, Rammer, etc.	1 Set
viii. Flakiness and Elongation Test Gauges	1 Set

ix.	Standard Measures of 30, 15 and 3 litres Capacity along with Standard Tamping Rod	1 Set
7.3	**For Cement and Cement Concrete**	
i.	Slump Test Apparatus	1 Set
ii.	Compression and Flexural Strength Testing Machine of 200T Capacity with Additional Diameter for Flexural Testing	1 Set
iii.	Cube Moulds for Concrete Tests	40 Nos.
iv.	Surface Moisture and Density Meter for Soil, Aggregate and Concrete	1 No.

8.0 Casting Yard

The Contractor shall make his own arrangements for identification, procurement/lease, development, establishment, operation and maintenance of suitable Casting Yard(s) required for execution of the Elevated Corridor Project including production of UHPFRC/UHPC girders, precast segments, precast components, trial casting, storage, curing, prestressing operations and associated construction activities.

The Casting Yard shall include all necessary infrastructure such as batching plants, casting beds, mould systems, stressing arrangements, curing systems including steam/controlled curing arrangements wherever required, laboratory facilities, storage areas, launching and handling arrangements, internal roads, drainage, power supply, water supply, safety arrangements, labour facilities and quality control systems complete in all respects.

The Contractor shall obtain all required approvals, permissions, environmental clearances, traffic permissions and statutory compliances required for establishment and operation of the Casting Yard at his own cost.

The location, layout and operational methodology of the Casting Yard shall be submitted to the Employer/Engineer-in-Charge for review prior to commencement of casting activities.

The Contractor shall also ensure uninterrupted production, storage, transportation and handling arrangements for UHPFRC/UHPC girders and precast components to suit the approved construction schedule and project completion requirements.

The quoted Contract Price shall be deemed to include all costs towards establishment, land arrangement, development, operation, maintenance, shifting, restoration and dismantling of Casting Yard(s), including all temporary and permanent facilities associated therewith, and no separate payment shall be made on this account.

9.0 Disputes

In case of Disputes arising between the Contractor and the Authority approving the Designs, the matter may be referred to the Managing Director (B-SMILE),. The Decision of the Managing Director (B-SMILE) shall be Final and Binding on the Contractor.

10.0 Defect Liability cum Maintenance Period

The Defect Liability cum Maintenance Period for the Project shall be Ten (10) Years from the Date of Completion of the Works and Opening of the Project Corridor to Traffic, unless otherwise specified by the Employer. The Contractor shall remain fully responsible during this entire period for rectification of defects, preventive maintenance, routine maintenance, periodic maintenance, structural performance, durability, riding quality, safety and serviceability of all Works executed under the Contract.

The Maintenance obligations during the Defect Liability cum Maintenance Period shall comprise routine, preventive and periodic maintenance activities necessary for ensuring continued structural safety, riding quality, durability, serviceability and uninterrupted safe operation of the Elevated Corridor Project.

The maintenance obligations shall include inspection, upkeep, repair, rectification and preventive maintenance of elevated corridor structures, UHPFRC/UHPC superstructures, portal frame structures, bearings, expansion joints, crash barriers, wearing course, drainage arrangements, utility corridors, lighting systems, road furniture, painting systems, structural components, footpaths, medians, retaining structures, parapets, road markings, signage and all associated civil, structural and utility works within the Project limits.

The Contractor shall ensure safe and uninterrupted movement of traffic during the entire Defect Liability cum Maintenance Period and shall promptly attend to all defects, damages, leakages, settlements, riding discomfort, structural distress, deterioration, joint failures, potholes, surface wear, drainage blockages, corrosion, utility failures or any safety-related deficiencies observed by the Employer/Engineer-in-Charge.

Maintenance operations shall include regular inspection, cleaning and upkeep of drainage systems, bearings, expansion joints, utility ducts, scuppers, rainwater disposal arrangements and all water conveyance systems, particularly before and during monsoon periods. Areas around bearings, joints and drainage outlets shall be maintained free from debris, dust, oil, grease and stagnant water.

Protective coatings, anti-carbonation coatings, exposed steel components, lighting poles, metallic fixtures, railings, parapets and crash barriers shall be periodically inspected and maintained to prevent corrosion and deterioration. Damaged road markings, signage, reflectors, lighting fixtures, safety furniture and utility covers shall be repaired or replaced immediately whenever required.

Preventive maintenance of UHPFRC/UHPC structural elements, prestressed concrete components, elevated rotary systems, portal frame structures, second-level carriageways, ramps, slip roads and associated elevated structures shall be carried out in accordance with approved maintenance manuals, IRC/MoRT&H Specifications, relevant BIS Codes and manufacturer recommendations wherever applicable.

Routine maintenance of at-grade roads, reconstructed pavements, slip roads, drainage systems, utility restoration stretches, footpaths, utility corridors and all ancillary works executed under the Contract within the Project limits shall also form part of the Contractor’s obligations during the Defect Liability cum Maintenance Period.

The maintenance obligations shall not include reconstruction or strengthening necessitated solely due to extraordinary events such as earthquake, major flood, cyclone, sabotage, fire, war, unforeseen natural calamities or damages caused by third-party agencies, unless such damages are attributable to defects in design, workmanship, materials or negligence of the Contractor.

The Contractor shall maintain proper inspection records, maintenance registers, defect rectification reports and periodic condition assessment reports and shall submit the same to the Employer/Engineer-in-Charge as directed from time to time.

The quoted Contract Amount shall be deemed to include all costs towards inspection, defect rectification, preventive maintenance, routine maintenance, periodic maintenance and all obligations during the entire Defect Liability cum Maintenance Period of Ten (10) Years, and no separate payment shall be made on this account

Abstract of Estimate			
Construction of Proposed Elevated Corridor from Sirsi Circle to Nayandahalli on Mysuru Road (Updated to issue rate dated : 08-10-2025 & 06-01-2026)			
Sl. No.	**Description**	**Amount in Rs**	**Percentage of Components**
1	Pre - construction Activities, Site Clearance & Dismantling	34450072.32	0.64
2	Foundation (Pile &Pile cap)	1473511317.00	27.37
3	Sub Structures (Pier & PSC Pier cap)	353147536.00	6.56
4	Super Structures (UHPFRC - U Girder)	2852639169.00	53.00
5	Reinforced Earth Approach ramps to super structures (RE Wall)	45079536.00	0.84
6	Wearing Coarse for super structures (SMA)	49388804.00	0.92
7	Finishing items for super structures (Crash barier, painting, Handrail etc)	89844993.00	1.67
8	Streetlight over flyover	24282294.48	0.45
9	Noice Barrier for controling noice on flyover	34054692.10	0.63
10	Reconctruction of White topping road at Approaches including all allied works	133069122.25	2.47
11	Restoration of existing road after completion of flyover construction and + Rainwater Harvesting	31468224.51	0.58
12	Re construction of Compoundwall at LA Location for Govt and private properties.	19137104.48	0.36
13	**Credit for Dismantled Material:** Deduct Salvage values from Dismantaled structures like SSM masonary (scarp material Steel 151.55 MT(from Existing ROB structures, RE Wall) RE earth from Dismantaled Existing RE wall structures 60% of existing earth is considered for reuse during new RE wall structures.	-119976.69	
14	Design charges @ 1% on total of above items 2 to 12	51400728.65	0.95
15	Maintenance charges for stand-alone projects like Bridge/ Tunnel /flyover works: the contractor shall be paid @ 0.25% of the Contract Price each for the first five years and @ 0.50% of the Contract Price each for the remaining period of five years. on total of items as per MORTH Ltr No.RW/NH-37010/4/2010-EAP(Printing) Vol - IV Government of India Ministry of Road Transport & Highways Dated: 05.03.2019 AT Model agreement page 76 under section 14.1 d and Miscellenious	191452675.38	3.56
16	**Amount Put to Tender (Civil Construction Cost)**	**5382806292.49**	**100.00**
17	**GST @ 18% on Amount Put to Tender**	**968905132.65**	2717193707.37
18	**Total Civil Construction Cost (APT+GST)**	**6351711425.14**	
19	Provision for Contingencies and Provision for Departmental Establishment Charges @ 1% on Amount Put to Tender (APT)	53828062.92	
20	Provision for Independent Engineer / PMC/DPR @ 1.50% on Amount Put to Tender (APT)	80742094.39	
21	Provision for Price escalation @ 5% , for the 2nd year i.e., 2.5% on Amount Put to Tender (APT)	134570157.31	
22	Provision for utility shifting @ 8% on Amount Put to Tender (APT)	430624503.40	
23	Provision for Arboriculture/ Afforestation @ 0.50% on Amount Put to Tender (APT)	26914031.46	
24	Land Acquisition Cost including Structures	1016923963.00	
25	Miscellaneous and other Department Deposits	4685762.24	
26	**Total Project Cost**	**8100000000.00**	
Estimated cost for Area and Km			
Cost / Sqmt (Structurer Area 76561.40sqmt) for structure (considering Foundation + sub + super structure + RE Wall approaches + Finishing + Lighting + Wearing course) = Rs.64,288/sqmt		**On Amount Put to Tender**	**On Total Project Cost**
Cost/Sqmt including all items from Sl. No. 1 to 15 & Cost/Sqmt including all items from Sl. No. iii to x		**74600.00**	**112257.00**
Cost/Km Viaduct length 6.181 + Approach 0.565km Total Length (including single lane loops + fourlane + single lane approaches) = 6.746km (equal to four lane Carriage Way is 4 .0Km)		**797925629.00**	**1200711533.00**